EDISON ELECTRIC INSTITUTE BULLETIN

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JANUARY, 1942

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EDISON ELECTRIC INSTITUTE

THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

October, 1941

SOURCE AND DISPOSAL OF ENERGY—MONTH OF OCTOBER

	1941	1940	%
GENERATION* (Net)			
By Fuel Burning Plants	11,033,940,000	9,396,059,000	+17.4
By Water Power Plants	4,202,162,000	3,659,176,000	+14.8
Total Generation	**15,236,102,000**	**13,055,235,000**	**+16.7**
Add—Net Imports Over International Boundaries	76,947,000	80,558,000	− 4.5
Less—Company Use	238,553,000	140,236,000	+70.1
Less—Energy Used by Producer	317,545,000	520,830,000	−39.0
Net Energy for Distribution	**14,756,951,000**	**12,474,727,000**	**+18.3**
Losses and Unaccounted For	2,393,863,000	2,077,800,000	+15.2
Sales to Ultimate Customers	**12,363,088,000**	**10,396,927,000**	**+18.9**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of October 31st			
Residential or Domestic	25,879,404	24,853,845	+ 4.1
Rural (Distinct Rural Rates)	981,057	681,000	.....
Commercial or Industrial:			
Small Light and Power	4,288,660	4,252,510)	+ 0.7
Large Light and Power	174,849	182,005)	.....
Other Customers	120,826	114,173	.....
Total Ultimate Customers	**31,444,796**	**30,083,533**	**+ 4.5**
KILOWATTHOUR SALES—During Month of October			
Residential or Domestic	2,091,593,000	1,922,059,000	+ 8.8
Rural (Distinct Rural Rates)	226,238,000	177,303,000	+27.6
Commercial or Industrial:			
Small Light and Power	2,099,961,000	1,886,007,000	+11.3
Large Light and Power	6,934,106,000	5,444,646,000	+27.4
Street and Highway Lighting	193,302,000	188,876,000	+ 2.3
Other Public Authorities	274,907,000	232,788,000	+18.1
Railways and Railroads:			
Street and Interurban Railways	322,321,000	320,928,000	+ 0.4
Electrified Steam Railroads	178,456,000	166,779,000	+ 7.0
Interdepartmental	42,204,000	57,541,000	−26.7
Total to Ultimate Customers	**12,363,088,000**	**10,396,927,000**	**+18.9**
Revenue from Ultimate Customers	**$228,833,300**	**$206,982,700**	**+10.6**

RESIDENTIAL OR DOMESTIC SERVICE (Revised Series)

AVERAGE CUSTOMER DATA—For the 12 Months Ended October 31st			
Kilowatthours per Customer	980	939	+ 4.4
Average Annual Bill	$36.75	$36.34	+ 1.1
Revenue per Kilowatthour	3.75¢	3.87¢	− 3.1

* By Courtesy of the Federal Power Commission

Vol. 10, No. 1, EDISON ELECTRIC INSTITUTE BULLETIN; published monthly. Entered as second-class matter Aug. 17, 1933, at the post office at Philadelphia, Pa., under the act of March 3, 1879. Publication office, 56th and Chestnut Sts., Philadelphia, Pa. Editorial office, 420 Lexington Ave., New York, N. Y. Subscription rate $2.00 per year in the United States; $3.00 per year in foreign countries.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 10 JANUARY, 1942 No. 1

Blackouts and the Electric Industry

Common Sense Precautions and Cooperation with Proper Authorities—Utilities Can Help in Allaying Hysteria—Experience of Utilities in First Six Weeks of War

BLACKOUTS have become a matter of public importance and the electricity supply utilities, as practically the sole purveyors of artificial light, will necessarily be much concerned with whatever may ensue, both as active agents in the proceedings that may be required and as passive recipients of the effects of sudden and sporadic shifts of the lighting load. Substantial technical problems are involved in each of these relations.

The outstanding problem presented by blackouts is not a technical one, however, but is an elementary problem in human relations although not necessarily easy of solution just because it is elementary; it is merely that of abating confusion in a situation that inherently tends to create confusion. Although the number of real blackouts or practice blackouts is almost negligible as yet (except on the West Coast), confusion appears to be quite well developed in advance with respect to the objectives to be sought and the methods to be followed. While this situation may not be particularly serious at this stage, since it involves only those having authority and the industrial services such as utilities who will be directly concerned with operations, it might well become awkward if general principles are not well established before the actual execution of blackouts is thrust upon the general public, for experience indicates that successful execution will be mainly in its hands.

Hysteria and misconceptions hold potentialities for doing far more damage to life and morale than any conceivable air-raids over this country. Assistance in allaying unjustified fears in their localities will be at least as valuable a contribution of the utilities and their employees to civilian defense as their part in the execution of such blackouts and other defense measures as may be considered necessary by the proper authorities.

Most of our information on blackout technique and practice and air-raid precautions is derived from British experience, and although this is valuable, it tends to lead toward measures that are not applicable to the American situation. In some cases these British experiences may actually be misleading to the public, since it is the blackout itself, rather than the entirely different situation in Britain which has been emphasized in the public mind. The greatest difference in the conditions applying to the two countries lies in the obvious dissimilarities in the geographical and military situations. When Great Britain undertook to blackout, it was well understood that hostile air raids would occur, probably with great frequency and regularity; therefore steps were taken to black out the whole country for the duration of the war or until the military situation has changed sufficiently to preclude the probability of damaging air raids. Suitable installations were made for this purpose and in particular the air wardens were intensively trained and the general public schooled in the routines of going about their ordinary affairs without the assistance of the lighting to which they had been accustomed.

"I said the air-raid warning's sounded. Pass it on."

Copyright, Punch, London

In America, quite a different situation prevails. The air raid precautions that may be undertaken are for drill purposes, and to ascertain how it shall be done if it has to be done in a more permanent way. It should be everywhere emphasized that normal activities shall be inter-

fered with as little as possible. There is no responsible opinion that hostile air raids will actually occur under the existing military situation. The miitary authorities are providing for every eventuality, as they are bound to do, but it should be stressed that the more optimistic estimates of the probability of raids come from civilian sources; it is altogether likely that a change in the military situation which make the likelihood of hostile raids more pressing will be duly provided for at the proper time. Meanwhile, the duty of common sense preparations, both physical and psychological, for such an emergency cannot be neglected.

The following comments are from the most recent collection of information on blackouts sent to chief executives of member companies by the Institute.

* * * *

Actual blackouts arising from military requirements have occurred in West Coast cities. There have been several practice blackouts in other localities, and several municipalities have enacted ordinances dealing with blackouts. These developments affect electric utility operations in a direct way; and utilities from their technical knowledge and practical experience may be in a position to offer helpful advice to military and civil authorities in this field.

None of the companies that has participated in blackouts appears to have encountered difficulties within the utility plant important enough to be discussed. The companies' main concern has been to render service to the local authorities to the end that the blackouts, both real and practice, might be effected with the least amount of confusion and hardship to the public.

Lines of Authority—Air Raid Protection Orders

Local governments may practice blackouts within their jurisdictions and enforce their orders through their police power. Coordination between adjacent municipalities or within more extensive areas may be effected by area boards or councils for this purpose. In one state a statute relating to blackouts and air raid protection has been enacted.

Where the Federal Government becomes concerned, the statutory powers for dealing with police matters resides in the War Department and this is habitually decentralized. At present, in coastal areas, orders pertaining to blackouts will come from the appropriate interceptor command of the Army having regional jurisdiction, and from there will be directed to local civil authorities who will have responsibility for executing blackouts. In general, except where otherwise ordered, the War Department authority pertaining to police matters is vested in the Corps Area Commanders. Each Area Commander, having the responsibility placed upon him, will discharge it, to a considerable extent, in his individual way.

Some confusion is bound to arise, on account of newness, as to the relative functions of the War Department, the Office of Civilian Defense, and the local police authorities. Some further confusion may arise as between the functions of the Federal Power Commission and the War Department. The detailed setup is sure to change from time to time. It is important in each locality to keep posted as to the current scheme for handling air raid protection matters because time is such an important factor in air raids and it is too late after the warning is received to find out who to take orders from and what to do. It is well to remember also against the time of real exigency, where the basic statutory authority resides; namely, in the local police authority, in the state police authority and in the War Department's designated regional Commanding Officer.

Electric Power and Light Circuits

Constant Potential Circuits to Remain Energized

At the outset, early in December, there appeared the natural disposition on the part of civil authorities to want to extinguish the sources of electric power supply by pulling the switches in stations and substations. The military authorities, acquainted with British experience, saw the necessity for keeping the circuits energized. The reasons for keeping them energized may be summarized for use where required:

> The power system supplies energy for all manner of electric loads as well as lighting. These comprise motors and all motor driven apparatus, such as elevators, ventilating fans, pumps; electrical heating devices of many kinds; refrigeration; practically all radio receiving sets; broadcasting, telephone, telegraph and signal services. They furnish the power to keep vital industries going, for essential lights in hospitals, at emergency exits of buildings, etc., and they supply a large amount of lighting that is important to the well-being of a community and can successfully and practically be screened. In short, the disadvantages of extinguishing all power circuits, as proved by much experience, far outweigh the advantages of keeping them energized.

Extinguishment of General Lighting a Responsibility of Consumers

The responsibility for extinguishing lights is properly placed on each individual consumer and it should be contemplated that he will turn out all lighting at the final circuit switches, or even at individual fixtures in order to leave other services unimpaired; it is in general not desirable that individual consumers shall turn off the main switches to their installations. In the case of premises where no responsible person is present during the hours of darkness, some ordinances provide that all lights shall be extinguished when leaving the premises. Others require that signs and billboards not normally under immediate control shall be extinguished for the entire duration of the emergency unless such control is provided.

Signs and Displays Not Under Immediate Control

Since many such installations are normally controlled by time-clocks or photosensitive relays, various expedients are being tried or considered, such as the employment of patrolmen, the use of control circuits, etc. The successful use of patrolmen appears to be of doubtful value on account of the probable infrequency and irregularity of alarms and the considerable uncertainty that they would be able to cover a reasonable beat in the required time following an alarm. Remote control systems have the disadvantage of requiring material, labor and time. The most promising development appears to be contained in a proposal that the owners or lessees of billboards or premises having after-sundown display shall provide switches accessible from the street whereupon it shall be the duty of air-wardens to turn off these switches in the event of an alarm; the effectiveness of this measure will, of course, depend upon the efficient organization of the air-warden system.

Emergency and Exit Lighting

Although not mentioned in some of the earlier and hastily executed ordinances, there appears to be a tendency to provide that emergency and exit lights normally required for multiple dwellings,

places of public assembly, etc., shall remain lighted but suitable shrouded. Some of these lights have been required to be on separate circuits heretofore; in such cases their selective treatment will be relatively simple.

Street Lighting

Electric utilities will ordinarily have direct responsibility for whatever requirements may be made for dimming or extinguishing street and highway lighting. Initially the requirements may call for complete extinguishment within two or three minutes of a warning alarm; some ordinances, in fact, provide that the extinguishment of street lights shall be an additional notice that a blackout is "on." This requirement is fairly easy to meet in the case of series lighting circuits, both for the circuits controlled directly from attended substations and those remotely controlled through pole-mounted constant current transformers in cascade connections. For speedily extinguishing street lighting circuits, one company has installed fire alarm circuits in all substations, and, when a blackout signal comes in, station attendants interrupt the lighting circuits without even taking the time to answer the telephone. The problem is not equally simple for circuits controlled by time-clocks or photo-sensitive relays, but this type of control may not be usual in large or thickly settled communities.

Auxiliary Street Lighting—Starlight Lighting

Serious consideration is being given to the provision of very dim auxiliary street lighting systems patterned almost directly on British methods. Briefly, this plan contemplates the use of an independent system of very small (10 watt) lamps, energized from the constant potential system, which is assumed to be everywhere accessible, relatively low mountings and specially designed hoods, at spacings quite close together according to American practice, to give a maximum of 0.0004 footcandle and an average of 0.0002 footcandle and to be continuously energized. *While substantially similar methods have apparently proved to be satisfactory in Great Britain, there is strong reason to doubt that they would be justified here.* Taking into account the very large amounts of already scarce materials which they would require, the large number of manhours of labor, the time that would be required to construct such systems, the substantial waste of electricity, the limited time that there is reason to assume they would be in actual use, the very small value of this dim light under our prevailing climatic conditions, and the good prospect that alternatives, if the value of the general scheme should become apparent, could be devised which would serve the purpose better at far less cost in scarce materials and labor, all serve to cast doubt on the value of the British scheme for use in America. In the event that some provision of auxiliary street lighting is required, it is strongly recommended that this should be done by stages, placing such lights first at only the most important street intersections, and then proceeding to the points of next importance, as experience clearly justifies this further expansion. To conserve materials, this should be done by improvisation, exercising ingenuity to make a maximum use of existing resources with a minimum requirement for new material and for labor. Surely it would be unwise to make heavy commitments for these commodities for elaborate schemes that may very well prove to be unsuccessful or unnecessary.

Dimming Existing Lights in Place

If a low level of illumination is demanded, there appear to be promising possibilities in the method of reducing the current in series circuits to the desired amount by reduction of the primary voltage supply to constant current transformers. Presumably the most simple way to reduce primary voltage would be by means of auto-transformers or series impedances which could be supplied in substations. In the case of pole-mounted cascaded transformers, some form of selective relaying would probably be required.

Blue light, which was widely accredited for dim-out purposes, is now condemned for that purpose, and we are told that red light is better. Practically any series lamp operated at reduced voltage to produce the equivalent of, say 10 candlepower will have a reddish tint. The most conspicuous advantages of reducing the candlepower of street illuminants in place are that it requires very little new material and that it uses existing locations presumably well chosen and familiar to the inhabitants.

The city of Chicago is considering a scheme to effect the protective concealment of military objectives in the metropolitant area by altering the characteristics light patterns of that area as it appears from the sky—by breaking up the lighting pattern of boulevards and diagonal arteries, by eliminating the lighting landmarks of the city, by reducing lighting in theatrical, business and neighborhood centers by blacking out different sections of the city at different times by adding false lights further to confuse the lighting pattern. If such a scheme were to come into use, dimming of sections of existing street lights would undoubtedly be a factor.

Opaque Hoods for Street Lights

If illumination is to be provided, the lights must be shrouded in any case to prevent any upward emision whatever, and probably to provide a cutoff substantially below the horizontal plane. This would apply to existing lamps and fittings, if used, and equally to any auxiliary systems that may be installed.

In view of the great diversity in glassware and fittings, it is highly desirable that elaborate specifications for such hoods should be discouraged. It is sufficient for specifications to establish the angle below horizontal at which cut-off is required and to require tightness against any upward leaks and adequate mechanical stability. Thereupon appropriate hoods may be devised locally from available materials.

It is the concensus of opinion of utility officials that have had any experience that complete extinction of street lights in a blackout is preferable to any scheme for dim lights.

Traffic—Emergency Vehicles

Most local ordinances contemplate immediate cessation of all vehicular traffic, except police, fire and emergency vehicles, following an alarm signal. In general it appears to be the intention to include utility service vehicles as emergency vehicles. In order to avoid confusion it will be desirable to arrange with the appropriate authorities in advance for emergency classification of appropriate vehicles, and for the required markings, special lights, etc.

Public Orders and Regulations

The experience of electric utilities on the West Coast, where air raid precautions have been more urgent than elsewhere, indicates that it is unwise for ordinances to deal in detail with provisions that may require specification. It is preferable that ordinances should do no more than state the broad measures to be taken and provide the necessary legal basis for these measures, leaving the detailed provisions to be established by the appropriate local executives, such as mayors or chiefs of police, who should be empowered to make them by procla-

mation. Experience already has indicated that prompt and perhaps drastic changes will be required in many details and if these details are frozen in laws or ordinances it is difficult to change them quickly to meet necessities.

Experience of one community has led to the conclusion that the following details should not be included in a blackout ordinance but should be left to an administrative authority: Details of blackout methods; mandatory systems of auxiliary blackout lights; details of lighting control methods, switching control, etc.; specifications for blackout lamps and installations.

According to "The American City" for January, 1942, Washington, D. C., Baltimore, Richmond, Atlanta, Los Angeles, San Francisco, Portland and Seattle have adopted blackout ordinances with broad powers to mayors and police chiefs.

Police and Air Raid Protection Personnel

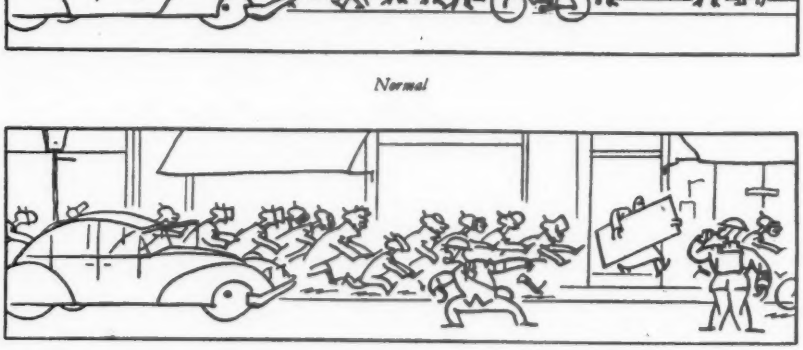
Some communities, faced with the police, traffic and other problems involved in air raid precautions, have made provision for the substantial increase of police force strength by means of special policemen for general purposes, and many communities are providing limited police powers to air raid wardens of various classes.

It is probable that most electrical utilities will have cooperated with other industrial and commercial employers in providing intra-plant protection for personnel, fire and other damage. In view of the public responsibilities of utilities, however, it may be necessary, according to established local requirements, to provide some kind of special police, or ARP warden status or other unmistakable identification for repair crews and emergency workers. It is equally important to ascertain that such workers shall not have been drafted for general ARP work at the expense of their availability for the emergencies for which they are particularly qualified.

THE CHANGING FACE OF BRITAIN AGAIN

STREET SCENE

Normal



The First Air-Raid Warning

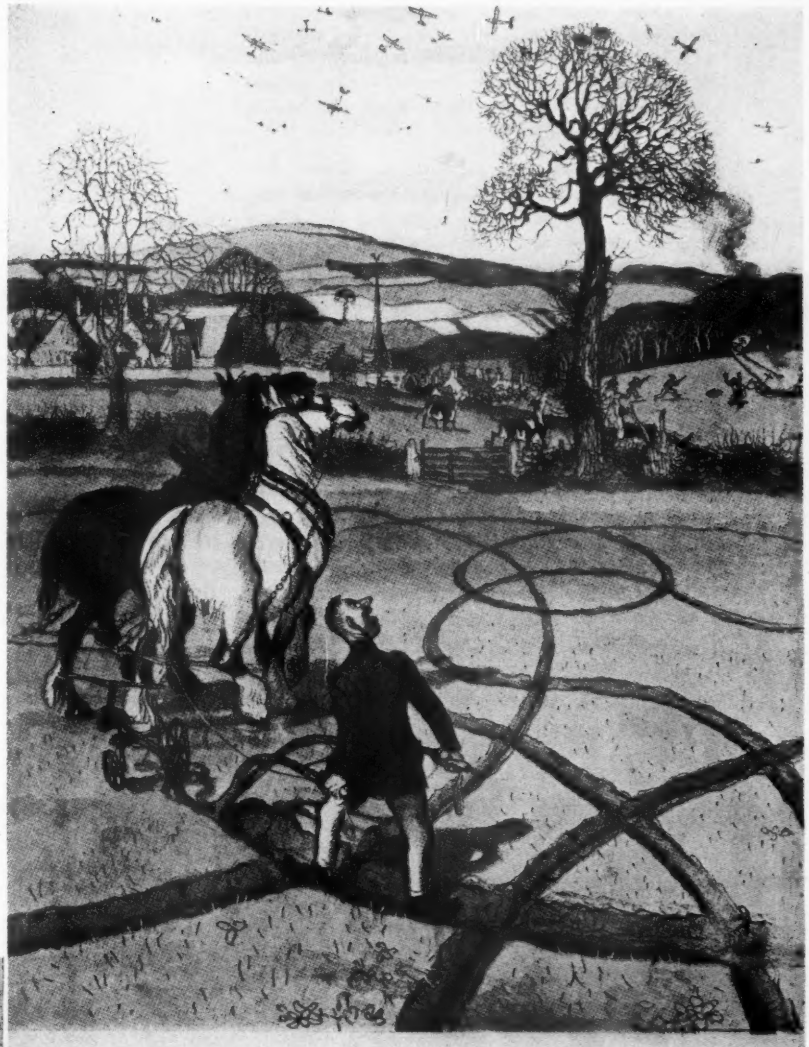
The Tenth Air-Raid Warning

The Hundredth Air-Raid Warning

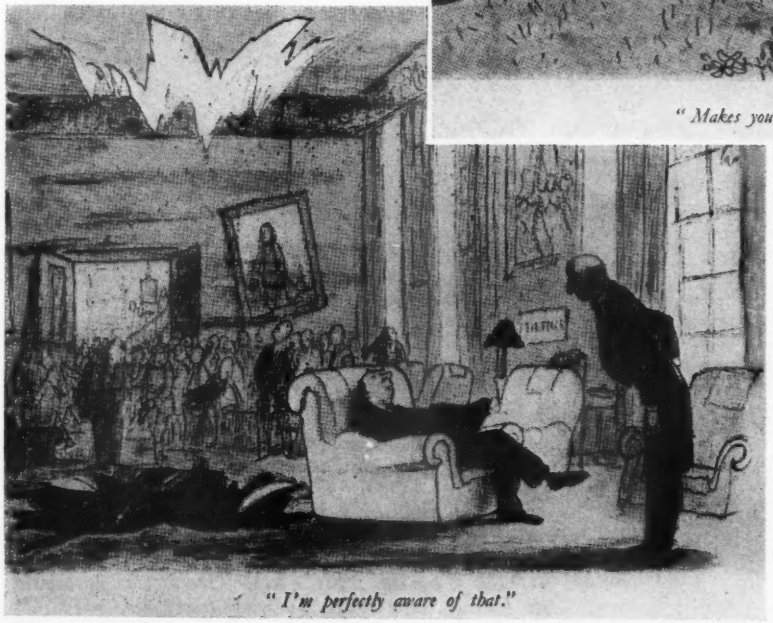
Punch Shows Us How England Takes It

"False alarms are costly enough in working time, but the British would regard as extravagant idiocy these American 'rehearsals' in which no planes are within 3000 miles, but the public is supposed to act as though 500-kilo bombs were already bumping around in the streets. * * *

"Maybe we will black out our seaboard cities. If we do, we should remember that more people will be slaughtered in a month by our own motor cars than would be killed in a year by bombs from the few carrier-based planes which might slip through in isolated raids, even if our cities were brightly lighted."—*William L. White in the New Republic.*



"Makes you fair giddy to look at um."



"I'm perfectly aware of that."

Cartoons from Sept. 11th, Oct. 30th, Nov. 4th, 1940, Jan. 15th, Feb. 12th, Feb. 26th, 1941, and Dec. 12th, 1917, issues of Punch. Copyright by Punch. Reproduced with thanks to the proprietors, Messrs. Bradbury, Agnew & Co., Ltd., London.

"I wish I could believe that the panic was over. But as I switch on the radio I hear two announcements from New York's City Hall. First, anyone who mutinously sasses an air-raid warden is now liable to a $500 fine or imprisonment. Second, the mayor instructs the public that when the aforesaid siren sounds, all dogs must be immediately tied up.

"Maybe this rule is copied from the British. But last winter when the siren sounded, the average Britisher would look up with a frown and say, 'There come the b——s again,' then continue reading his paper or paring his nails. I never saw any Englishman start scrambling around the house to capture his dog and truss him to a bed leg.

"Now I have not only a small daughter but a small dog. Since he is a dark brown Scottie, I would adjudge him pretty well blacked out and ready for raids, except when he rolls the whites of his eyes. Since he has a dignified and calm disposition, he would not bite anyone or start a panic and I see no reason for tying him up. But if we ever do have a genuine air raid with actual danger, I shall immediately take the subway down to City Hall and tie up the mayor."—*William L. White in the New Republic of Jan. 19, 1942.* Mr. White has spent the greater part of the war in Europe.

HIS USUAL SEAT

"Excuse me, but is there an air-raid on?"
"Yes, I think so."
"I'm much obliged. My friend's up from the country and he's never seen one."
O. L. Stampa, December 12th, 1917

"All I can say is, it's either Grace going upstairs or the barrage, NOT *Daphne coming downstairs or H.E."*

Commercial Outlook for 1942

Adjusting to Business Unusual

By C. E. Greenwood
Commercial Director, Edison Electric Institute

THE Pearl Harbor bombing raid—a courteous gesture of the Japanese in knocking at America's door to announce a state of war—was a potent factor in bringing public realization of the precarious position of this country. These United States had been standing on the brink of warfare for months, and yet it surprised us when we were plunged into deadly conflict. A flurry of excitement, which in spots develops into mild hysteria, is to be expected. These are the times we must keep our feet on the ground.

The Pacific incident brought the preparedness issue into bold relief. Arguments relative to errors of omission and commission of those in government authority are justified on both sides, but perhaps the statement most disarming to the critics came from Mr. Winston Churchill when he said in substance—"You in America have been busy helping to fight England's battles, richly aiding in production and supply of the sinews of war for us." Mr. Churchill might have added that now production must be multifold because we have a Class I war of our own. Yet we must not fail the needs of England, nor Russia, nor China, nor any of the allied nations. Sounds fantastic! So do the actual figures that interpret this industrial production job which President Roosevelt announces as the bogey.

But wait a moment—that is just ships, planes, tanks and guns. What about the pyramids of ammunitition and vast supplies of materials for our expanding army and navy. There is but one answer. Business knows it, and representatives from numberless concerns have been making the trek from home—wherever that may be—to Washington to get enlightenment on just to what degree civilian output must be curbed. In fact, there are those who ask "Can we survive?"

In an all-out war period such as we face in 1942, the survival of certain classes of industry will be dependent on the ability to adjust tools and equipment for the production of new materials, and the speed of that adjustment. Witness the automobile industry. Then the radio industry is to be called upon to manufacture upwards of one billion dollars worth of army and navy equipment. That in dollars is approximately twice as much business that the radio industry will ordinarily gross. Quick sales and smaller profits will keep that industry on even keel. However, civilian supply of new equipment will be drastically curtailed.

The refrigerator industry is assumed to be next for drastic transformation to war production. The washer-ironer industry has been hard hit on output for civilian needs. During World War #1 there was a shift of servants in the home to machines in factories, and the problem of home laundering under these conditions won a place for electric washers on the essential list of the then War Industries Board. History may repeat itself.

The women of England who work out by day have demanded electrical servants to help them during their hours at home. In this writer's opinion a similar situation will obtain in the United States as its armed forces grow to full strength. Migrations of labor will add to the confusion of complete mobilization, and readjustments in home living are inevitable.

Out of these drastic restrictions in manufacturer output of electrical household appliances will come an enforced standardization which will have its advantages in production costs, and if models are chosen wisely, will contribute to volume in marketing at the propitious time. Expect this to be evidenced in the refrigerator, range and water heater fields in particular. Models of electric refrigerators of any given year, when displayed in toto by any dealer dominated his showroom. Prospects that have not satisfied their refrigerator needs up to now are going to choose from fewer models and larger sized boxes instead of selecting from the four, five and even six foot sizes—and like it. National promotion has been pointing out consistently to housewives the economy in buying larger boxes than they think they require. Now necessity may accelerate acceptance of the idea. Larger food storage allows for quantity buying at lower unit prices and eases the strain on the family budget.

The utility industry has already investigated and announced its desire to encourage the standardization of tank sizes of water heaters and the manufacturers have been ready cooperators in forwarding the effort. Progress will be speeded up. Electric water heating service will have its place in the home, in the dairy and in industry during the emergency.

We have just closed a banner year in the electric range market. Of the somewhat over 700,000 ranges sold, a small percentage were special models for defense housing installations. Army barracks and navy quarters at many locations have depended upon electricity as a fuel for cooking over several years. During World War #1 civilians used electric ranges to conserve coal. Electric "cookers" in blitzed areas of London were repaired and moved to homes at suburban points, following the population to give an efficient, safe and healthful cooking service.

It is quite probable that in the not too distant future the demands on the range manufacturers for cooking equipment for defense housing projects will tax the limited output because of restricted supply of essential metals. We may expect Victory models to appear. Civilian demands may be satisfied only after long delays. Midyear will give us a better picture than now.

In the light of the battle of production, there will be much reduced national magazine advertising on major items of kitchen equipment. Nevertheless there is an obligation on the part of the electric industry—the utility manufacturer and dealers—to promote the use of present equipment. The advantages to be gained by the industry in selling electrical living

must not be buried in the war period. It was Mr. Leon Henderson who said recently, "We must first see that the use of materials essential to defense is curtailed as much as possible in civilian goods, and at the same time we must do all we can to expand production of articles essential to maintaining living standards on the highest possible level."

Now what about lighting? Will we blackout this troubled nation which has become more light conscious than any in the world. We have made extraordinary advances in public understanding of the intimate relationship of light and sight. Advances in science of lighting have been accompanied by applications of light for adequate seeing for all tasks. Scientifically designed lamps are available at prices possible for the humblest homes to enjoy. See them among the dwellers of slum clearance projects and in the homes of the "economic royalists."

Better Light-Better Sight has maintained that high intensities of illumination in the factory contributed to faster production, better products, better morale. War production industries are proving it. Better Light better pupils is a fact nationally demonstrated in practice. Better Light in business has an economic value too firmly established for even the quibblers to deny. Accidents on the highway mount to new figures when we test blackouts, and crime is rampant. Better Light means safer streets and highways.

Is the laborer, the pupil, the store employee to be content with 5 foot-candles at night and 50 to 100 by day. If one reads the remarkable lamp sales record of 1941, the answer is "No." It is gratifying that there was an increase of 235,000,000 lamps sold. But most satisfying is to note that the demand for lamps of 200 to 1500 watts increased 16 per cent while that for lower wattages gained only 6 per cent. There is more money to buy lighting equipment now among the labor group than in many years. Manufacturers of lighting equipment are resourceful and may be successful in finding substitutes for certain essential metals which will enable consumers to have scientifically designed lamps. "Sight is priceless — light is cheap."

Until air raid shelters are at our very doors, why not a "safety room" or rooms in every home arranged for cooperating 100% in darkening but equipped with adequate sources of illumination. We must hope that in a wave of patriotic enthusiasm, our sense of values is not lost. When terror strikes, we want to obey the rules we have learned to the letter and seek the safety we have established. Let's blacken the windows for our protection but "brighten the corners where we are" for morale.

The Home Service women of our industry can make helpful contribution to the Victory Program through aiding the homemakers in upholding this family morale. Miss Caroline Haslett, President of the Women's Engineering Society in England, and Director of the Electric Association for Women there, has just been traveling in this country. In a recent interview she said:

"Home economists in the United States should not rush off to war service because they have most important duties to perform in helping customers maintain morale of their families by maintaining cheerful homes behind the blackout, preparing nutritious meals and by showing customers how to get more wear from properly using their electric washers.

"People stay at home more under blackout conditions and our government wants the homes to be cheerful, occupied by people living as normally as possible. Therefore the home economists must help on blackout procedures, with proper lighting in the home and proper cooking for the family. Our government considers this very important work and utility electric company employees have been classified as in a reserved occupation."

This is a wise rule for American women to follow.

The commercial forces of our industry are streamlining their organizations to render assistance to the war effort on all fronts. There is a job to do of huge dimensions. Domestic consumers must be shown the most efficient use of all electric services and how to save time and money by the use of electricity. The economy theme weaves through the buying, storing and preparation of food; into the washing, ironing and cleaning and incidental services. There can be no let-up in telling the story of thrift through use, and in selling appreciation of electric service.

There are yet household appliances to buy in broken lines. Should all manufacture stop tomorrow, it would take several months to exhaust present supply in wholesaler and in dealer stocks. There will be more appliances manufactured but limited in quantity. Then there are those myriads of idle "servants" in every home that are not working because crippled and in need of fixing-up, or because of inertia on the homemaker's part.

As the supply of new equipment is cut, why not put to work a past investment by electrical consumers which, if inventory were taken, would total in hundreds of thousands of dollars. The reviving of idle range services is also a man-sized task in itself.

In this considerable undertaking of approach to consumers under present conditions, the dealers in electrical equipment who are now jittery in curtailment of supply of products, and as restricted terms of purchase close in on them, should be of assistance to the utility. The dealers have a stake in seeking out and repair-

"The demands of civlization have made man more and more dependent on artificial light, which in turn has fortunately become progressively cheaper, more efficient and more abundant."

ing the crippled home electric appliances.

A thought might be injected here that even the limited supply of major equipment will not go out the store door without sales effort. In the past year sales encroached on 1942 volume in anticipation of the shortage and credit limitations that now exist. It is significant that in 1941 installment sales in the United States set an all-time record reaching a total of $6,800,000,000. About 90% of this volume represented sales of automobiles, refrigerators, ranges, washing machines, vacuum cleaners and miscellaneous household equipment. And installment business was but approximately 13% of total retail trade.

It is present misunderstanding among many prospective purchasers that all deferred payment credit has gone out the window. An enterprising newspaper in Cincinnati—THE TIMES STAR—ran a series of advertisements last month to clarify regulation W of the Federal Reserve Board and create public interest in buying on time. The results were highly satisfactory. The maximum now of eighteen months, although low percentage wise compared with three to five years maximum, was considered by our industry liberal indeed but few years since.

Although rural line extensions are held in abeyance for the duration, there is a farm market that should be plowed and developed for electrical equipment sales as part of the war emergency program. The United States Department of Agriculture states that in 1942 farmers should put "every acre of land, every hour of labor, and every bit of farm machinery to the use which will best serve the nation's war time needs." Farm prices are now at a 12-year record. An OPM Limitation Order provides increased production quotas of many farm appliances. The order permits such quotas based on 1940 production levels as follows: 142% for deep well jet pumps and 100% for large shallow well pumps; 100% for electric tank heaters; 206% for milking machines; 157% for cream separators; 122% for other dairy equipment; 115% for brooders.

On the thousands of machine shops operating 24 hours daily depends the deliveries of tools to win the war. Good lighting for efficient, comfortable seeing speeds up production.

Here lies opportunity for utilities and dealers for developing greater electrification of present farm customers. What are we waiting for!

Now only men of robust health can score Victory on the firing line; only if we have a corp of healthy and willing laborers can we depend upon all-out production; only if we maintain a basically healthy business can we win the economic battle now waging. As a key defense industry, the electric utilities have been preparing for the time when power supply must take care of unprecedented industrial production. The increase was 30% in 1940. At this time there is indication that such increased demands on available power capacity will not much more than keep pace with the losses in power demands from mortality of civilian production loads.

The servicing of these industrial power loads will keep every power engineer of utility commercial departments on the alert. Not only will he study and assist in serving industrialists who have defense contracts, but he can take part in the adjustments of the smaller factories, particularly those producing for civilian needs who are squeezed in the contest of metals. The utilities have already been asked to assist in a survey of facilities of production. A number have investigated

Mills making clothing for the Army and Navy are running overtime. Good lighting is imperative for the workers on this intricate close seeing task.

already the tool facilities in metal working plants on their lines. That is to be the call of the day, and every divisional office of WPB will look to the utility for cooperative effort in the approach to both present industrial customers and prospective ones as well. This is a prelude to further sub-contracts activity. The idea is old in American business but the problems are new in the war effort that confronts us. When tools are found to do a job, that is a start in the right direction, but trained labor and managerial skill are equally indispensable. Despite the limitations, the existing possibilities must be exhausted.

Power men can perform a distinct service in aiding local planning for this survey, therefore contributing to the gigantic production effort and to the welfare of local industry.

The light and power companies have completed a year of remarkable growth with increase of 2,800,000 kilowatts in new generating capacity. An increase is planned in 1942 totaling 3,660,000 kilowatts. The safety factor in power supply is therefore reasonably satisfactory for the coming year. Management is bending its energies to effect economies in operation. Conservation is the watchword.

It was in the spirit of forwarding the Victory Program on all fronts that the statement of commercial policy of EEI was issued. It is of interest to Institute members that committees have been changed to meet these business situations. Over-all will be the General Commercial Committee and under this will be committees on Lighting, Home Service, Industrial Power and Heating, Farm Utilization, Dealer, Electric Water Heating, Appliance Maintenance, Wiring, and last but not least Post War Planning. The last named committee will have profound deliberations ahead. We must ever keep in mind that after the weapons of war have stopped rolling off the lines we must start measuring with the yardstick of peace. It may be three or even five years from now but the day of reckoning will come.

What then is the goal of commercial men for the months ahead? In general summary, it is a pledge that the goodwill of each company shall be maintained through striving to better serve war production activities; through supporting effort to save the smaller industrial customers who have been producing for civilian needs; by motivating repair and maintenance program and otherwise vitalizing business to keep afloat the stable dealers in electric equipment in the communities served, and by continuing to keep people thinking electrically, and trying to remove obstacles to the aid and enjoyment that electric service can give in the home and on the farm which do not conflict with the Victory Program.

Yes—there is a stupendous job ahead, and commercial men must show courage and determination to survive.

Power Outlook Reassuring for War Demands

WITH a present surplus of more than nine million kilowatts of generating capacity above the greatest demand for power, and with the construction of an equal amount in prospect during the next three years, the outlook for sufficient electric power to meet all war demands is reassuring, C. W. Kellogg, President of the Edison Electric Institute, reported in a news release of Jan. 22. At the same time he indicated that it was possible that a few localities affected by drought or by excessive piling up of defense loads may face a limited amount of power rationing.

Mr. Kellogg's statement was based on the results of a survey just completed to determine the effect of the great increase in scope of government expenditures incident to America's entrance into the war.

Final figures for December, 1941, show an increase of 11.4 per cent in the sum of the "peak loads," or maximum demands upon the electric generators, over December, 1940. For all utility power houses of the country, this indicates a total demand of 35,100,000 kilowatts upon generators whose combined capacity is 44,350,000 kw. To this margin of 9,250,000 kw will be added new construction of 3,664,000 kw in 1942, 2,746,000 kw in 1943 and probably as much in 1944, indicating all together a margin of over 18,000,000 kw, or more than 50 per cent of the present electrical demand, to meet war expansion of the Nation.

This extra 50 per cent of power does not take into account any additional generating capacity being built by factories for their own use. Electric output of industrial plants generating their own power last year constituted about two-fifths of all industrial electric power.

In 1941, the output of electricity in America totalled 205 billion kilowatt hours, of which 168 were generated by public utilities and 37 by factories for their own use. During this same period, according to a recent report of the Federal Power Commission, quoted in the *Electrical World*, the energy consumed in making U. S. government products totalled 7,257,913,975 kilowatt hours, while the total disbursements for national defense, as shown by the U. S. Treasury, were $12,531,000,000. This indicates a ratio of six-tenths of a kilowatt hour per dollar of defense expenditures and compares with a figure of eight-tenths of a kilowatt hour per dollar value of products determined by the U. S. Department of Commerce for 1939. If it is assumed that total war expenditures will reach 56 billion dollars in 1943, in accordance with the announced objective, or about four and a half times the 1941 amount, then the increase in electric output directly for the increased war load will run from 32 to 35 billion kilowatt hours, or from 16 to 18 per cent of the 1941 grand total.

Estimated increased output, of course, would be modified downward substantially by the decline in the volume of output for manufacture of products for purely civilian uses, which has been emphasized by the government as a certain corollary of increased war production.

Insurance Rates for Performance Bonds Are Reduced

THE EEI Insurance Committee announces that the Towner Rating Bureau, Inc., which is the organization of the insurance companies having jurisdiction over rates for contract bonds and similar instruments, has reduced the rates for performance bonds required to be given by public utilities in connection with contracts for supplying gas or electric lighting to cities or municipalities.

The old rate was $2.50 per $1,000 of the annual contract price with a minimum annual premium of $5.00. The new rate is $2.00 per $1,000 of the annual contract price with a minimum annual premium of $5.00. This change in rate was effective Dec. 12, 1941, on performance bonds covering new contracts. On current bonds the reduction becomes effective on the anniversary dates.

War-time Problems to Dominate
E. E. I. Engineering Committee Winter Meetings

WAR-TIME measures and problems will dominate papers and round-table discussions at the Winter Meetings of the Engineering Committees of the Institute to be held during the month of February. The Electrical Equipment Committee will hold its meeting at Pittsburgh on February 2 and 3; the Transmission and Distribution Committee at Cincinnati on February 9 and 10; the Prime Movers Committee at Baltimore, also on the ninth and tenth, and the Accident Prevention Committee at Pittsburgh, February 23 and 24.

Accident Prevention Committee

Problems connected with the protection of property and personnel will be the main consideration of the Accident Prevention Committee. The attention of the Committee will be directed to the avoidance of accidents during blackouts of steam and electric stations, as well as on the street and highway. It is expected also that considerable time of the meeting will be devoted to the subject of gas and incendiary fire defense.

Another subject of timely interest to men concerned with safety in the utility industry is the situation with respect to rubber protective equipment and other safety material and equipment. Several manufacturers will provide information and give their view with regard to this matter so that utility men may be prepared for any necessary adjustments in operating procedure which may have to be made, in view of threatened shortages.

Reports of sponsors of various committees will be received and time will be arranged on the program for a Round Table discussion. These discussions will be of particular value at this meeting because of the many new ideas and methods that have been developed in the various companies since our country's entry into war.

Representatives of member companies of the Institute are invited to attend.

Electrical Equipment Committee

A session sponsored by the Operating and Maintenance Division will be devoted to "Self-Help" salvaging of scrap material, reclamation and rehabilitation of equipment, and to war-time operating and maintenance problems, including guarding of plants and sabotage protection. Data covering the affect of war on substation design, will be presented at one session sponsored by the Apparatus and Design Division. Apparatus troubles, oil fires, oil circuit breakers and annual bushing report will be other subjects at this session. Generator and insulation testing, station design, unusual sources of power and circuit breakers and switchboards provide the main subjects for another session of this division.

The defense load, system capacity reserves, and a report on the operation of the Southeastern power pool will be the principal topics at the System Engineering Division Session.

At the concluding session a paper on Matching Load and System Capacity will be followed by Progress Reports of the Utilization Division and the Meters and Services Division.

Transmission and Distribution Committee

All sessions of the Transmission and Distribution Committee will be devoted to operations under war conditions. The first session will have war-time design and operation of underground systems as its general subject. Other sessions will cover: Conservation of Man Power; Power Company Problems During Blackouts; Changes in Design to Utilize Substitute Materials; Reclamation and Salvaging.

Tentative Programs—Subject to Slight Revisions

ACCIDENT PREVENTION COMMITTEE

GEORGE S. DIEHL, *Chairman*

William Penn Hotel, Pittsburgh, Penna., February 23 and 24, 1942

FEB. 23—9:00 A.M.

Accident Statistics
Changes in Basis of Collecting E.E.I. Accident Statistics A. B. CAMPBELL
Accident Statistics Report.....E. H. KREH
(Note: Members are requested to bring their questions concerning the A.S.A. code classification.)
Avoidance of Accidents During Electric Station Blackout D. C. STEWART
Avoidance of Accidents During Steam Station Blackout F. H. DAVIES

FEB. 23—2:00 P.M.

Street and Highway Safety with Reference to Blackout..H. F. WEBB
Transmission Problems.....H. O. SPRINKLE
(Note: The latter half of this session will be closed—attendance limited to committee members and representatives of power companies.)

FEB. 23—8:00 P.M.

Resuscitation Report.....W. R. SMITH
Low Voltage Hazards Report.....C. B. BOULET

FEB. 24—9:00 A.M.

Rubber Protective Equipment Situation.....T. R. CLAFFY
Procurement and Care of Linemen's Equipment, Belts, Tools, etc. R. M. GODWIN
Safety Equipment Outlook as Affected by Defense..J. T. RYAN, JR.

FEB. 24—2:00 P.M.

Gas and Incendiary Bombs.....W. P. YANT
An Educational Program for Industrial Fire Protection J. A. McGUCKIN
"They're Dropping Incendiaries." A Film Produced by the Associated Factory Mutuals.

ELECTRICAL EQUIPMENT COMMITTEE

R. W. WILBRAHAM, *Chairman*

Hotel William Penn, Pittsburgh, Penna., February 2 and 3, 1942

FEB. 2—9:30 A.M.

(Attendance limited to members and guests sponsored by members or the chairman)

Operating and Maintenance Division

H. S. FITCH, *Chairman*

Self Help ..... H. S. FITCH
Useful Salvaging of Scrap Materials ..... G. SUTHERLAND
Reclamation and Rehabilitation of Equipment ..... S. M. DEAN
Mutual "Self Help" Schedule ..... H. S. FITCH
Operating and Maintenance Problems ..... E. S. FITZ and C. T. HUGHES

FEB. 2—1:30 P.M.

(Attendance limited to members and guests sponsored by members or the chairman)

Apparatus and Design Division

B. VAN NESS, JR., *Chairman*

Apparatus Troubles ..... F. S. BROWN
Informal Round Table Discussion
Oil Fires ..... R. N. CONWELL
a. Presentation of Annual Report
b. Discussion.
Joint Committee on Oil Circuit Breakers ..... R. T. HENRY
Annual Bushing Report ..... R. T. HENRY
Station and Substation Design ..... H. B. WOOD
Effect of War on Substation Design ..... A. V. DEBEECH
Revision of Rotating Machinery Standard ASA C-50 ..... H. E. KENT

System Engineering Division

H. A. DRYAR, *Presiding*

Operation of Southeastern Pool ..... C. W. MAYOTT
Carrying the Defense Load ..... H. W. PHILLIPS
Review of Progress Report on Generating System Capacity Reserves ..... H. A. DRYAR
System Capacity Definitions ..... STANLEY STOKES

FEB. 3—9:30 A.M.

OPEN SESSION

Apparatus and Design Division

B. VAN NESS, JR., *Chairman*

Generator Insulation and Testing ..... H. J. KLUMB
Report of Insulation Tests at Philadelphia ..... B. R. NEVINS
Station and Substation Design ..... H. B. WOOD
a. A Preliminary View of the Electrical Features of Southwark Station ..... E. B. SHEW
b. Unusual Sources of Power
Wind Driven Generator ..... H. E. DEARDORFF
Power from Testing Gasoline on Diesel Engines ..... S. M. DEAN
Solar Motors ..... R. N. CONWELL
Generator Driven by Process Water ..... E. S. FITZ
Circuit Breakers and Switchboards ..... E. B. SHEW
a. Special Code Requirements—Air Circuit Breakers and Air Supply Systems.
b. An Unusual Air Supply System for Air Circuit Breakers.

FEB. 3—2:00 P.M.

OPEN SESSION

System Engineering Division

H. A. DRYAR, *Presiding*

Matching the Load and the System Capacity ..... W. J. LYMAN

Utilization Division

J. H. FOOTE, *Chairman*

Report on Progress ..... J. H. FOOTE

Meters and Services Division

A. E. SILVER, *Chairman*

Progress Report of the Meters and Services Committee F. E. DAVIS

TRANSMISSION AND DISTRIBUTION COMMITTEE

E. V. SAYLES, *Chairman*

Cleveland Hotel, Cleveland, Ohio, February 9 and 10, 1942

(Attendance limited to members, representatives of power companies and invited guests)

FEB. 9—9:30 A.M.

T. G. HIERONYMOUS, *Presiding*

Announcements

Wartime Design and Operation of Underground Systems

Increased Cable Ratings for War Industry Loads E. W. OESTERREICH
AEIC Simplified Practice Schedule—Specifications for Impregnated Paper Insulated, Lead Covered Cable ..... G. B. MCCABE
The Air-Cooled Transformer ..... W. W. SATTERLEE
Better Lightning Protection of Cable Terminals ..... M. W. GHEN
General Discussions of Underground Systems.

FEB. 9—12:00

A. B. CAMPBELL, *Presiding*

Wartime Conservation of Man Power

Man Power Must Be Conserved ..... C. B. BOULET

Feb. 9—2:00 P.M.

G. H. FIEDLER, *Presiding*

Power Company Problems During Blackouts

Blackout Lighting ..... DR. S. G. HIBBEN
Technical Problems in Connection with Blackouts ..... O. K. CORNELL.
Prepared discussions relative to practices now being used or considered.

FEB. 9—8:00 P.M.

Blackout Lighting Demonstration at Nela Park

Feb. 10—9:30 A.M.

F. E. SANFORD, *Presiding*

Changes in Design to Utilize Substitute Materials

The Use of Substitute Materials in Transmission Line Design H. J. HENDERSON
Modern Designs for Wood Substations ..... BEN H. HUGHES
Some Examples of Modern Wood Substations ..... H. N. FOX
The Preservative Treatment of Wood with Pentachlorophenol DALE CHAPMAN

Savings in Steel Effected by Direct Pole Mounting of Transformers, and
Second Report of Joint EEI-NEMA Committee on Standards for Distribution Transformers ..... A. E. SILVER and H. M. JALONACK

FEB. 10—2:00 P.M.

W. F. NIMMO, *Presiding*

Used Materials—Their Importance and Methods of Reclaiming

The Useful Salvaging of Scrap Materials ..... GEORGE SUTHERLAND

Why Good Lighting Will Help Win the War

By H. Freeman Barnes

Member, Executive Committee, Better Light-Better Sight Bureau

WE ARE rich in natural resources. We have in our own country most of the vital metals and materials which are needed. But beyond these vital, earthy things is one other important element which goes into the making of machines.

That other element is . . . TIME.

Machines are made of metals, chemicals . . . and time. The nations which make the most efficient use of time are the nations which may well win this war.

Conservation of materials is in everybody's mind. "Waste not," is a term which all of us understand and are conscientiously attempting to apply. In thinking of the importance of conservation, I asked one of our famous scientists not long ago what he thought were the two most important things to conserve. Naturally, I expected him to talk in terms of metals or chemicals, and therefore was quite surprised when he said, *The two most important things for America to conserve are Time and Energy. Important because they are the most difficult to conserve. By regulation and allocation we can conserve material things. But time and energy are even more important — and are hard to conserve because by and large their use is entirely up to the individual.*

To these two important factors—time and energy—I have added a third, eyesight. LIGHT plays a major role in saving time, saving energy, and reducing eyestrain. Remembering that every nation has twenty-four hours in each day, if we can be clever enough to produce *more* in each twenty-four hours than our adversaries, we increase our chances of winning the war.

We know that light—good light—lots of light—increases production. Therefore, it saves time.

We know that light—good light—lots of light—saves energy.

And we know that light—good light—lots of light—decreases eyestrain, and helps save energy, helps save time, adds to cheerfulness and morale.

Any product or service which has a direct major and immediate effect on saving man hours—or making man hours more productive—is something that should be put into effect at once. Stop and think—what other such time or energy saving devices do you know about in addition to LIGHT?

The continued good health of every worker in industry is vital. The worker who is sick, or only half sick, is wasting precious man hours. To keep this worker healthy we have the problem of diet, rest and exercise—as well as freedom from personal worries. But there's no way of automatically regulating diet or rest or exercise. It has to be left up to the individual.

Lighting, on the other hand, is something that once a management decision is made, can be ordered today and, in effect, put in tomorrow. Its effect on the increased production of all workers is immediate.

If you would grant that LIGHT could increase production only 3%—and estimating that some time this year there will be six million people employed in defense industries, that increase in production would mean 300,000,000* man hours more per year. That many man hours, if applied to ships, planes and tanks, would mean:

43,000 Light Tanks,
or 12,000 Training Planes
or 2,400 Big Bombers
or 100 Destroyers
or 11 Battleships

Here are some recent examples of reports from manufacturers:

1. A manufacturer of wood working machinery reports that under new lighting, micrometers are easily read and it takes 15% less time to make settings and adjustments on machinery.

2. A machine tool manufacturer says that inspectors on the night shift are enabled to turn out as much work as men on the day shift. No lost time now as a result of men walking away from machines every hour or so to relax.

3. Another machine shop reports 25% reduction in spoilage; 5% increase in production per man hour and 50% reduction in accidents due to poor seeing.

4. A hosiery manufacturing company finds that machine repair time has been cut down 20%.

5. A paper board manufacturing company reports that there is a definite loss of time due to headaches, etc. A check-up at the store room dispensary has shown a decrease of approximately 30% in calls for headache tablets.

6. In the office of a chemical manufacturer the typing on printed forms has been speeded up 12%; billing machine production bettered by seven per cent; and shorthand transcription by 20%.

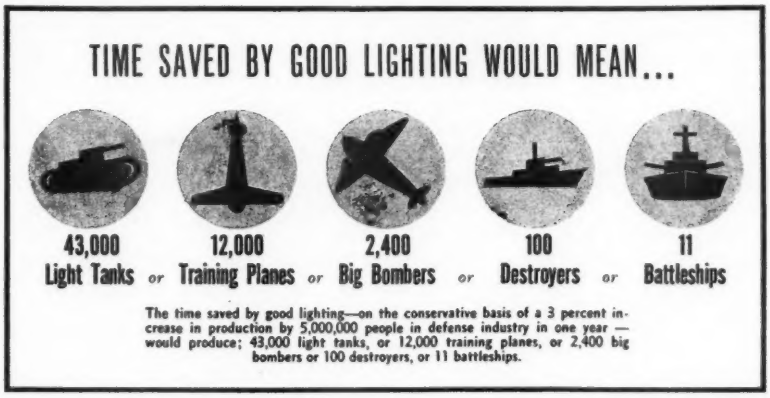
7. A textile manufacturer showed an increase in weaving efficiency from 80% to 84%.

8. In the finishing department of a manufacturer of metal parts, there was a 4% reduction in spoilage and an increased output of 8%.

9. A shipbuilding company tells us that men are now able to work just as well at night as during the day—with no rejects in welding operation of night crews.

10. A machine tool manufacturer, after re-lighting, says that now tools and machinery can be used anywhere in the shop, with no time lost going to the window for good light to read micrometers.

We can multiply these instances time and time again. The pity of it is that, with our whole production system

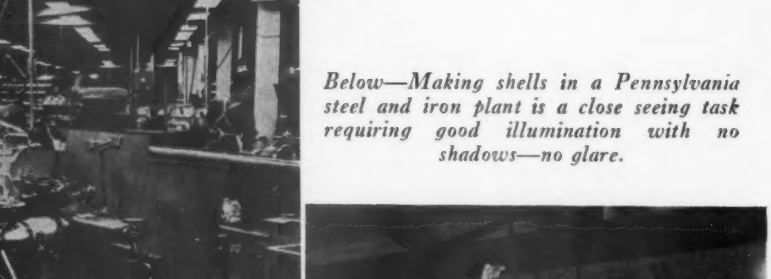

TIME SAVED BY GOOD LIGHTING WOULD MEAN...
43,000 Light Tanks
or
12,000 Training Planes
or
2,400 Big Bombers
or
100 Destroyers
or
11 Battleships
The time saved by good lighting—on the conservative basis of a 3 percent increase in production by 5,000,000 people in defense industry in one year — would produce; 43,000 light tanks, or 12,000 training planes, or 2,400 big bombers or 100 destroyers, or 11 battleships.

Courtesy, Lighting and Lamps

*It is estimated that 1,000,000 out of the 6,000,000 workers in vital industries already have modern lighting. If better light increased the production of the remaining 5,000,000 workers by 3%, it would be the equivalent of adding 150,000 men. Assuming 2,000 hours per year, this equals 300,000,000 man-hours annually.

Left—Full speed ahead in a big aircraft factory in California, with high intensity fluorescent lighting for the workers.

Below—Making shells in a Pennsylvania steel and iron plant is a close seeing task requiring good illumination with no shadows—no glare.



pointed toward maximum output—at whatever cost—*every* plant is not *already* using modern lighting to add that additional three, five, or even fifteen per cent increase in production.

While the study of the effects of lighting on the seeing system is most intricate and complicated, the principles involved are very simple indeed. Perhaps we can express them this way:

a. When we increase the amount of light upon an object, we, in effect, do two things:
(1) We magnify that object.
(2) We improve the contrast between the object and its background.
b. As a result of doing these two things, we:
(1) See the object more quickly
(2) See it with more certainty
c. Because we see faster, and see more accurately, we therefore:
(1) Save time
(2) Save energy
(3) Save eyestrain

That isn't very complicated or hard to understand, is it? And yet, thousands of businesses, turning out not only war materials but other essentials such as clothing and supplies for the armed forces, do not have the type of modern lighting they need—and we need—as a nation—if we are to crowd the greatest possible production into every hour of the day.

If we are to have an army of even three million men—with fourteen persons backing up every soldier—that means some forty million people taking part in a vast production and transportation program. While real modern lighting won't affect the efficiency of all of these millions, it should average at least 1%. And that's the equivalent of 400,000 more persons at work. That's how important lighting is—we don't dare underestimate it.

Let's take that conservative figure of 3% increased production—and imagine that these additional man hours could be immediately translated into the sinews of war. We'd have a Light Brigade** consisting of:

2 Battleships
10 Destroyers
250 Big Bombers
500 Fighter Planes
500 Big Tanks
1,000 Medium Tanks
1,500 Light Tanks
Plus—Food, Ammunition, Supplies

That's how important light is to this country of yours and mine. That's how important are the things we have to sell. We aren't selling just fixtures and tubes and wire and switches; we aren't really just selling higher intensities of light; we're selling a major production tool that is automatic in its effect on production. It's a tool *every* business man can order today and, in effect, *put in tomorrow.*

Light *increases* production—and decreases *errors*—without adding to floor spare, without hiring new men, without installing new machines. More space, more trained men, more machines are desperately needed but, today, tonight, or tomorrow, we can step up present production with light—real light, lots of light.

You and I want to do anything and everything we can to help in this all-out emergency. We'll do our job as members of civilian defense—and do it willingly and enthusiastically. But we can do another important job in our business hours . . . that of educating and telling . . . and yes . . . selling . . . the tool of production that we know most about. Thousands of businesses don't have man-hour saving light. They don't know about it—they may not agree that more light is needed. They may be difficult to convince. They may look on light as just another expense—but *our* job is to

**Based on reliable figures that it takes 125,000 man-hours to build a four-engine bomber,
25,000 man-hours for a fighter plane
15,000 man-hours for a big tank
10,000 man-hours for a medium tank
7,000 man-hours for a light tank
27,000,000 man-hours for a battleship
3,000,000 man-hours for a destroyer
Approximately one-half of the 300,000,000 man-hours (See footnote No. 1 above) would build the Light Brigade above, leaving the other half to produce food, ammunition and supplies.

bring the facts to them—keep after them without *ever* giving up—convince them of the importance of this modern production tool—and feel proud of the part *we* are playing in making this "Light Brigade" a reality.

That battleship, or destroyer, or tank or bomber which we *don't* have—at a critical moment, because we didn't produce it when we had the opportunity, may be the difference between victory and defeat, in some important egnagement.

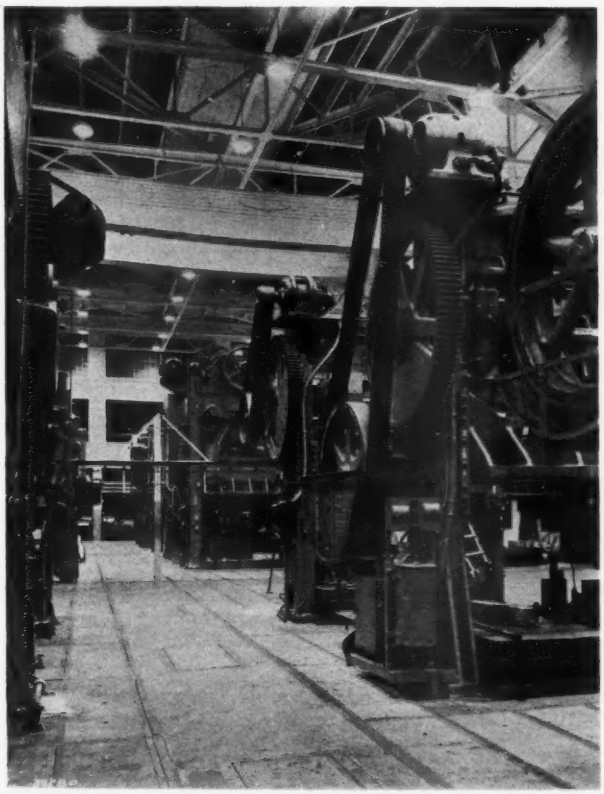
And it isn't only the factories that need time and energy saving light. Wherever we can save man hours with Light, we should not neglect telling the story of what light can do—whether it be in the office, the store, the service shop, or the home. Particularly is good light needed in the home. We are not consistent if we try to save energy and reduce eyestrain in the factory or in the office, and then let that same important producer go home at night and continue to use his eyes, under seeing conditions which do not send him back to work in the morning at top efficiency.

While our bodies and minds may be relaxed at home in the evening—reading, studying, sewing, playing games, etc.—there's no let up in the work that eyes may be called upon to do. Wherever eyes are put to work—and even the simple process of reading is work for the eyes—Americans can and should—and must—provide lighting that produces the minimum of eyestrain and uses up the smallest amount of energy.

This year, in the homes of defense workers alone, if we do nothing about it, there will be four billion*** man-hours of eyestrain lighting.

Add that to the ten billion† man-hours of production-losing lighting in offices and factories, and perhaps you'll agree with me that the lighting industry has its job cut out for it in helping Win the War.

In drafting rooms and busy offices begins the first steps in "all out" war production materials requiring the best lighting for efficient "seeing."



40 footcandles of glare free general illumination in this bomb producing plant maintains the same production schedule as under daylight conditions.

With all the lighting progress that we have made during the past few years, there still remains a greater percentage of our factories, offices, streets and homes that are woefully lighted.

Poor lighting is a peace-time luxury.

We could afford until now to waste time and energy in our work or to indulge in night accidents on our streets—but not today! Today, we must take advantage of everything we know—to produce fast—faster—faster—by saving valuable man hours. If we could improve our present street and highway lighting, for example, we would save an estimated 200,000,000 man hours in one year—man hours which will otherwise certainly be lost, due to preventable accidents or deaths in night-time driving.

We can't waste time today. We must have daylight indoors, twenty-four hours a day and seven days a week.

***Based on an estimate of 2¼ hours per night in the homes of 5,000,000 defense workers (See foot-note on page 13.) who need better light. This is 11,250,000 man-hours per night or over four billion annually.

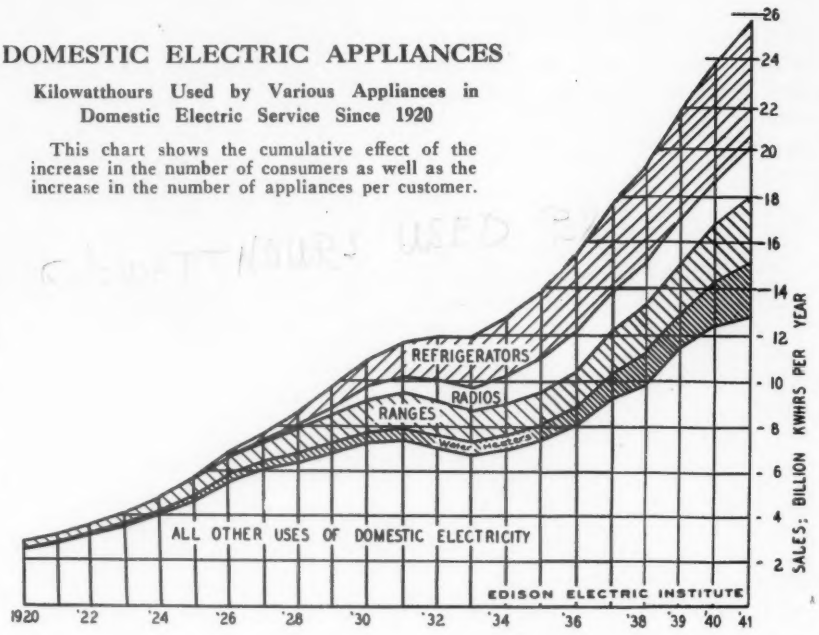
†Based on 2,000 hours per year for each of the 5,000,000 defense workers who need better light at their work.

Domestic Electric Appliances in 1941

ALL records were broken in the sales of domestic electric current-using appliances in 1941. Total retail sales approximated $1,625,000,000, as compared with $1,305,000,000 the year before and the previous high record of $1,360,000,000 in 1929, and the low record of $470,000,000 in 1932. Largest individual item was 3,575,000 refrigerators at $554,000,000. Next in dollar volume were sales of 1,900,000 washing machines at $150,000,000 and 728,000 electric ranges at $103,000,000. Of the total sales of $1,625,000,000 about $65,000,000, or 40 per cent, were for replacements.

The small table below shows the approximate total dollar volume of sales of electric current-using appliances and the total kilowatthours used for domestic service during recent years. The last column is interesting because it suggests that, since 1938, each dollar of appliance sales produces every year a smaller increase in the amount of electricity used.

Year	Approx. Appliance Sales (million $)	Total Kwhr Domestic Service (million)	*Increase* in Kwhr, per $1 Appliance Sales
1933	535	11,875	...
1934	645	12,800	1.43
1935	870	14,125	1.52
1936	1,175	15,850	1.47
1937	1,315	18,050	1.66
1938	800	19,750	2.13
1939	980	21,550	1.84
1940	1,305	23,850	1.76
1941	1,625	25,750	1.17



The large table gives a preliminary estimate of the amount of electricity

(*Continued on page* 36)

Energy Used by Domestic Electric Appliances—An Estimate for the Year 1941

Appliance	Number in Homes On Dec. 31, 1940 (1)	Number in Homes On Dec. 31, 1941 (2)	Saturation (3)	Average Number in Homes 1941 (4)	Kwhr per Year per Appliance, in Normal Use (5)	Per Cent in Normal Use (6)	Effective Kwhr per Year per Appliance (7)	Total Kwhr Used in 1941 (8)
Lighting & miscellaneous uses	.....	.....	....	(Per customer 328 kwhr)	..	..	....	8,582,000,000*
Refrigerators	16,235,000	19,250,000	72%	17,750,000	354	90	318	5,645,000,000
Ranges	2,556,000	3,184,000	12%	2,875,000	1,200	85	1,020	2,932,000,000
Water Heaters (all types)	800,000	980,000	4%	890,000	3,500	75	2,625	2,336,000,000
Radios and Phonographs**	25,500,000	26,750,000	100%	26,125,000	100	80	80	2,090,000,000
Flatirons**	25,500,000	26,750,000	100%	26,125,000	80	80	64	1,672,000,000
Oil Burners	2,000,000	2,250,000	8½%	2,125,000	250	95	237½	505,000,000
Washing Machines	12,350,000	13,350,000	50%	12,850,000	30	80	24	308,000,000
Vacuum Cleaners	15,000,000	16,150,000	60%	15,575,000	24	85	20	312,000,000
Roasters	1,230,000	1,470,000	5½%	1,350,000	300	75	225	304,000,000
Percolators, glass	3,750,000	4,475,000	17%	4,112,500	80	75	60	247,000,000
Toasters	13,050,000	13,950,000	52%	13,500,000	30	50	15	203,000,000
Electric Clocks	12,800,000	14,700,000	55%	13,750,000	15	95	14	193,000,000
Ironing Machines	1,575,000	1,775,000	6½%	1,675,000	125	80	100	167,500,000
Space Heaters	5,400,000	5,700,000	21%	5,550,000	50	50	25	138,500,000
Percolators, metal	4,625,000	4,600,000	17%	4,612,500	50	50	25	115,000,000
Total Appliances	.....	.....	....	.....	....	..	....	17,168,000,000
Total Domestic Service	.....	.....	....	(Per customer 986 kwhrs)		..	....	25,750,000,000*
Number of Customers	25,500,000	26,750,000	....	26,125,000				

Notes: Columns (1) and (2): Estimates largely from ratios shown in "Electrical Merchandising" and other trade papers; being based upon the summation of annual sales of appliances less an estimated replacement demand. Column (4): The arithmetical average of columns (1) and (2). Column (6): An estimate allowing for duplicate and unused appliances, houses unoccupied; summer cottages, vacation periods, etc. Column (7): The product of Columns (5) and (6), representing the actual kwhr per year per average appliance in the home. Column (8): The product of Column (4) and Column (7).

* Preliminary figures.

** Many homes have duplicate sets of radios and flatirons, whose grand total is not possible of determination. From general indications, however, it appears that these duplicate sets do not greatly change the total amount of electricity used. In this table, therefore, the assumption is made that the saturation of these appliances is complete and the energy use is calculated upon the total number of homes.

Industrial Safety and the War Effort

By John Stilwell
President, National Safety Council

IN his proclamation of August 18, 1941, the president of the United States said:

"I, Franklin D. Roosevelt, President of the United States of America, do hereby call upon the officers and directors of the National Safety Council to mobilize its nation-wide resources in leading a concerted and intensified campaign against accidents, and do call upon every citizen, in public or private capacity, to enlist in this campaign and do his part in preventing wastage of human and material resources of the Nation through accidents."

On September 9, 1941, some 130 national organizations met in New York City at the suggestion of the National Safety Council, to consider ways and means of carrying out the President's proclamation. An Emergency Safety Campaign was launched, and these co-operating organizations pledged their every assistance in a drive to eliminate accidents as a part of the national defense effort.

Events since December 7, 1941, have made this pledge even more important. The Nation is now at war. Our efforts must be not only for defense, but toward the complete destruction of the forces that threaten us. To secure this objective, any factor tending to hinder the production of materials vitally needed must be eliminated.

Accidents do hinder production! Total calculable accident costs in 1940 totaled around $3,500,000,000. The cost to industry was approximately $700,000,000, representing 17,000 deaths and 1,400,000 injuries. Had we diverted into productivity the billion and one-half man-hours lost in 1940 through work accidents, these hours would have been sufficient to construct 27 battleships, 200 destroyers, or 75,000 fighter planes.

War facilities will now be required in ever-increasing quantities, and accidents must not stop their production. Injuries destroy time and morale as well as increasing costs. These factors contribute to reduced production. It is from these standpoints we must consider existing safety programs.

In doing so we must first analyze past accidents. Were they due to speed-up, inadequate training, or violation of safety rules? Did they result from improper guarding of machinery, lack of suitable protective equipment, or just a plain lack of knowledge? These questions are important. More important, however—Is our safety program in tune with the times? Or are we operating a 1942 plant with a 1935 safety program?

The time has come to consider this point. The primary job is to put the safety program on the table, weigh and test it. Has it produced results? What can be done to make it more efficient? These questions can best be answered by the individual company; some operate excellent programs, other do not.

One question is highly important. Are the executives of industry really in earnest when they talk of accident prevention work?

In plants where consistent reductions in accidents have been made, interest and responsibility of management in safety has been fundamental. Closely allied to this have been the efforts of safety men in these organizations to do all they knew should or could be done to prevent accidents.

These plants have put into practice the principle that those who are responsible for operating the plants and who have authority to remedy conditions must also have a sympathetic attitude toward safety, and recognize it as a management problem—a management responsibility.

The plant manager must convince his men, by visible signs such as mechanical safeguards, good maintenance, and adequate protective equipment, that he is behind the program. It is highly important that superintendents and foremen follow through and give the program intelligent cooperation. This can be brought about by convincing the whole organization that safety and efficiency go hand in hand.

In every industrial organization there should be some one appointed to head up the safety program. If the plant is too small to support a full-time safety director, then a responsible individual in the organization should be assigned to the work. In some smaller organizations, the manager himself takes charge. In any event, it is highly important that someone assume this responsibility.

The initial job of the man in charge of safety is to conduct an analysis of past plant accident reports and records. These should bring to light certain salient facts. First of all, departments should be rated according to their accident experience, thus giving a clue to where intensive corrective efforts should begin.

Second; conditions, agencies, and practices causing accidents are found, and here, also, immediate steps for improvement may be taken.

Third; the weak and strong points of certain foremen and supervisors, as they relate to accident prevention, are found. When additional education in safety is indicated, the safety director knows where to direct his earliest efforts.

Fourth; individual workers suffering repeated injuries are discovered. With this information available, the safety engineer may determine the causes for these accidents; whether due to physical handicaps, wrong mental attitudes, or lack of training or skill.

Too much emphasis cannot be placed upon organizing and maintaining a complete injury reporting system. To the safety man, the use of plant accident statistics can be as valuable as the cost sheet is to the production manager.

Extensive plant inspections should be made, to include machines, tools, fire hazards, fire protective facilities, electrical hazards, chemicals, lighting, ventilation and housekeeping. All material handling equipment, tools, ladders, and power transmission apparatus should be thoroughly checked. The safety man should assist in this work but should place considerable responsibility on foremen, supervisors, and employees.

Inspection supplements accident record analysis in locating unsafe conditions and accident causes. Many of these conditions can be eliminated at the source by careful examination of plans and specifications for all new equipment and processes. It is important that guards be included in the design of machines; state safety laws complied with; and design in conformity to accepted safe practices.

Similarly, purchase orders for equipment and materials should be checked. Specifications should cover approved

safety devices and guards, and only those machines fully protected or equipped with necessary safety devices should be purchased.

Certain materials purchased for use in the plant may present serious hazards of flammability or toxicity. To minimize health and injury hazards, provision must be made for the safe storing and handling of such materials.

Control through plant layout and design can be a most important factor in preventing injuries to employees and damage to equipment. In a plant where pedestrian and truck traffic is heavy, the location and size of aisles and the situation of machines at work areas are often determining factors in the accident experience. When new buildings are erected, these factors can easily be provided for, but in existing plants the problem may be more difficult.

One of the most important activities of management in the control of accidents is the elimination of mechanical hazards. Many serious injuries are due directly to lack of mechanical safeguards. If the frequency and severity of accidents are to be reduced, guards and safety devices on mechanical power transmission equipment, on moving parts of machinery, at points of operation, on open-sided floors and working platforms, and the like, are essential.

In the course of normal plant operations, many workers are subject to serious hazards that cannot be fully eliminated by mechanical guards. Workers engaged in handling materials, electricians, welders, polishers, and grinders, mechanics, furnace men, and many others need such additional protection as is provided by personal protective equipment.

In handling certain types of material, employees can be protected by wearing goggles, safety shoes, shin guards, protective hats, and gloves. Electricians need rubber gloves, rubber blankets, line hose, and similar equipment. Welders need face masks, aprons, and gloves; grinders and chippers and many other employees need goggles.

Intensive efforts should be made to secure the wholehearted cooperation of workers in the safety program. An appeal for this cooperation may be communicated by personal letters from management; through bulletin board announcements; departmental meetings; or at meetings of employees. Wide publicity should be given the effort, and every means at the disposal of management used to arouse interest and a desire for cooperation.

The safety education program should aim at the elimination of both work accidents and off-the-job accidents. Off-the-job accidents mean lost time, lower production, less efficiency in operation, in equal degree to plant accidents.

Many accidents have occurred because workers have been placed on jobs for which they were physically and mentally unqualified. In certain occupations, workers are especially liable to injury if they have physical defects, such as defective vision and hearing, or are "below par" in some other way. Workers are often unaware of any physical defects previous to physical examinations. Following examination, conditions may be corrected by proper placement, and adjustments made to new occupations, reducing the possibility of injuries.

Consequently, the selection and placement of workers is an important factor in controlling accidents. If a worker is selected on the basis of a thorough physical examination, in addition to other requirements, accidents resulting from physical deficiencies will be reduced to a minimum or entirely eliminated.

The proper placement of workers, however, does not end the job. Logically, the next step is to train the worker properly for the particular job he is to fill. It is important that he be made familiar with all the operations he is to perform, and particularly the hazards involved. Such a program is called "job training," which means simply training the worker to do the job the one best way, which is the safe way.

In most concerns, job training is primarily the function of the foreman or supervisor, who should determine that each employee in his department thoroughly understands how to work safely. that the proper mechanical guards are in place, and that the necessary personal protective equipment is provided.

A further aid can be obtained by means of efficient, thoughtful supervision. Workers under lax supervision are apt to take chances, to use short cuts, and to remove guards, all of which lead to many of the so-called "unforeseen accidents." It is frequently the simplest and smallest operations that are overlooked by the supervisor which result in injuries. Attention to such minor details, proper instruction and training, followed by close, personal supervision, will go far in controlling injuries.

The safety program can also be advanced through the use of posters and bulletin boards, distribution of safety literature, promotion of inter-departmental and inter-plant contests, and numerous other means.

It is extremely important that management be kept informed on progress made. Furthermore, it is advisable that the plant manager attend safety meetings from time to time, not only to encourage others by his presence, but also to keep in touch with the work.

Highly important is the organization of plant safety committees. These generally consist of a general safety committee, a foremen's safety committee, and an inspection committee.

The general safety committee should be the policy-forming group in matters affecting plant safety. Its membership may vary from four to any greater number, but it should always be made up of an executive, a foreman, a worker, and the man in charge of safety. If more than four members are appointed, the balance between foremen and workers should be maintained. Meetings should be held at regular intervals, usually once a month, and records should be kept of the proceedings.

The foremen's safety committee is a working committee that applies the general program directly to problems in the department. The membership is composed principally of foremen, but it is always desirable to have several workmen in the group. Again, the size of the committee will vary according to conditions, but it is well to have this committee as large as possible, since it is a valuable means of training both men and supervisors.

The plant inspection committee consists usually of a foreman and two workmen who make weekly or monthly inspections of the plant for the purpose of discovering and having corrected unsafe conditions and practices. Holes in the floor, unguarded machines, unguarded construction, openings, poor housekeeping, defective machines, or, in short, any conditions which is likely to cause injury to men or interrupt production, are examples of physical hazards they should single out and have corrected. Discovery of unsafe practices is highly important, too.

The reports of the inspection committee should be reviewed, and the necessary action ordered on each recommendation.

(*Continued on page* 40)

British Experience in Overcoming Raid Damage to Electricity Supply

Actual Damage Has Generally Been Purely Superficial

From the *Electric Review* (London) of Nov. 7, 1941

WITHOUT giving away any secrets to the enemy we may say that it was inevitable that of the very large number of bombs dropped over Britain during a period of over twelve months, some lucky, or rather unlucky, ones at least should from the very law of averages have come to ground on or near power stations. Even where this has happened, thanks to the design of the modern power station and the special precautions taken against blast and fire, the actual damage has generally been purely superficial. Actually, one of our newest generating stations which had a direct hit on the boiler house roof sustained no harm that bricklayers and concreters could not put right in a few weeks, the plant itself being unscathed. Apart from a few honorable scars there was no sign of its maltreatment when we visited it a few weeks after the incident.

In some instances damage to power stations is looked upon rather more in the light of annoyance and a test of endurance than anything else. One undertaking has had the turbine house roof blown off twice and the chief engineer referring to it told us that he would have to summon all his sense of humor to see the funny side of it if it were blown off again. "Still," he said, "the enemy comes along and blows the place up and you set to work to put it together again. When with the praiseworthy help and enterprise of the contractors you eventually see order arise from chaos, you begin to wonder what there is to talk about. I suppose it resolves itself into a trial of who gets tired first."

After damage has occurred at a power station the restoration of supplies has been much simplified both by the existence of the grid and by the foresight shown in providing a pool of apparatus upon which undertakings can call. With reference to this, however, the importance of each undertaking planning well ahead exactly what it will do in the event of damage to each particular section of its plant is emphasized. If this is done even the most serious "mishap" assumes a straightforward aspect and a great deal of wear and tear on the engineers responsible is avoided. To quote one actual instance a high explosive bomb completely wrecked the switchhouse of one generating station. Yet, due to a cut and dried scheme of action, supplies were restored within the remarkably short period of 24 hours, despite a slight delay in the delivery of the pool gear—a delay which, incidentally, would not be likely to recur today, now that the procedure for obtaining the apparatus has been studied and improved.

The pool gear installation is, of course, only an emergency measure and not intended for permanent use. Furthermore, supplies of this gear are not unlimited and it is of importance to get it released at the earliest possible moment. In this connection a word must be said for the excellent work done by manufacturers in carrying out the necessary overhaul of damaged apparatus in the minimum of time.

Substations, like generating stations, stand up to an enormous amount of punishment, unless, of course, they receive direct hits, and seldom sustain worse harm than blown-out doors, windows, or roof lights; here incidentally the protection provided for the apparatus has been invaluable as an immediate protection against rain. But even if, in the case of the less substantially constructed units, more serious damage is done to the structure, the chances are that the transformers, switchgear, etc., installed will still be serviceable.

As an example, we were recently shown a substation which had until recently been constructed of breeze-blocks in order to harmonize with a housing estate. A bomb caused the walls and roof to collapse completely over the plant, which, however, still continued to function. It was, indeed, possible to clear away the debris and build a brickwork erection around it without disturbing the apparatus. The protection of transformers, by building round them sandbag walls from 2 ft. 3 in. to 3 ft. thick or double walls of sheeting filled with ash, has been found effective in preventing damage due to flying iron

Royal Engineers at work in a large crater in the London area

roof principals and splinters of all kinds.

With regard to rotary substations, several points again emphasize the importance of being ready for all emergencies. The precaution has been adopted by some undertakings of building frameworks over the machines, covering them over with galvanized sheets. This arrangement has undoubtedly prevented severe damage from failing glass and burning timber.

Damage by Mud and Water

In addition to damage caused by debris, etc., from blasted buildings or road surfaces a considerable danger arises from the blasting of mud into the windings of the machinery, especially in dry weather. The mud also has a tendency to pack underneath the brush gear almost like granite, and the windings and the end-risers become one solid mass. The necessary protection is easily afforded by means of shields. In cases where roofs have been lost by blast, portable canvas structures are proving invaluable for enabling the machines to be restored in the minimum of time and also for protecting them from the weather.

Naturally, considerable damage has been caused to the plant in some instances by water, but in practically all cases it has been found possible to dry out without permanent injury. A further complication is provided in certain coastal areas where salt water is employed for fire fighting. Some engineers have even contemplated washing the plant down with fresh water, but we have not yet heard of such drastic treatment being actually applied.

The modern brick-built substation seems to withstand fire equally well as blast and we recently saw one standing intact, the sole remaining building in the center of a wide expanse of burnt-out premises. In the old types of building damage appears to be limited to the destruction of the wooden under-sheeting and principals of slated roofs caused by sparks blown from burning adjacent buildings into crevices, notwithstanding the efforts of the roof fire-watchers. The great thing is to prevent the incendiaries from lodging in the roof or in the gear, and it is recommended therefore that, besides enclosing the equipment wherever practicable the roofing should be as thin as possible. The incendiaries will then in most cases fall straight through the roof, glance off the gear if it is underneath and burn out harmlessly on the concrete floor. For the protection of switchboards and other vital apparatus and machinery "Durasteel" sheeting has fully justified the claims made for it. We have seen several instances in which it has saved valuable plant beneath and has itself sustained no worse damage than discoloration.

Substation Fires

Though fires in substations caused by incendiaries are uncommon, it is a sound scheme to have an arrangement with the fire service to notify the electricity undertaking if fires occur affecting any of its property, since it is obviously undesirable and dangerous for the Fire Service, which is in any case not normally provided with foam apparatus necessary for dealing with burning transformer oil, to work among live gear.

The importance of being in close touch not only with the Fire Service, but with the other civil defense services and public utility undertakings does not need emphasizing. From the electricity undertakings' point of view it enables its repair work to be carried out speedily on specific instructions and with the maximum cooperation with the water, gas, G.P.O. and transport services. On occasions electricity undertakings' own private telephone systems serving substations, etc., have proved invaluable for keeping communications open when the G.P.O. services have been affected. Radio diffusion services have also played an important part in giving warnings of imminent danger to the locality.

Effects upon Cables

As might be expected the greatest amount of damage which supply engineers have to face is that caused by bombs to underground cables. Actually, however, experience has shown that paper-insulated, lead-sheathed and armored cable stands up to the very severe damage, irrespective of voltage, and we may mention that on one occasion it was only the electric cables which held up a damaged bridge.

Numerous instances have occurred where the cables, depressed and twisted many feet below the laid level, have not failed. From observations made of these cases it has sometimes, though not always, been found that the stretching of cables laid direct in the ground has been confined to the length of the cable in the crater, and does not extend any appreciable distance on either side. Frequently any slack in existence in adjoining manholes has been sufficient to prevent damage to joints. Where cables are drawn through ducts it is found, as might be expected, that they are pulled along the duct towards the crater and the wipes of joints are torn away from the lead sheath, often two or three manholes away from the crater.

Disturbance of Joints

Sometimes this pulling of cables in ducts extends for a considerable distance —in some cases as far as 300 or 400 yards. In these cases as many as three straight-through joints in series have been pulled out, and the cables pulled up to the nearest bend in the duct run, where the ducts are usually disturbed and the cables pulled tight on the corner. Sometimes it is found that the cores have been broken inside of lead sheathing.

In other instances where the feeder cables were not harmed switching out has occurred due to damage to the comparatively frail pilot cable. Such incidents can often be detected by the absence of the earth leakage alarm signal. A reference to the position of joints in regard to a crater should be made in order that any joint in the immediate vicinity can be remade. Another form of cable trouble liable to occur at outdoor transformer points in rural areas is injury of the lead sheath by falling splinters, and the precaution should always be taken of providing suitable strong covering.

It is obviously inadvisable to retain the normal method of having the whole of a network interconnected by means of feeder pillars and substations; systems should be divided into as many areas as possible in order to localize the effect of any damage, to relieve the strain on converting plant and to reduce short-circuited energy developing at the side of the fault.

This makes it possible also to divide up the personnel (mains engineers, junior assistants, and mains foremen) to operate in separate districts, and thus faults in all districts are covered simultaneously. Many undertakings have also been saved from very serious interference with the maintenance of supplies by forethought in providing alternative duplicate or even triplicate primary transmission systems at various points, and it should be the aim of every authority to see that there are as many feeding points into the system as possible. Duplicate supplies to especially important consumers have similarly helped enormously. In an early issue we hope to outline some of the measures that have been taken to restore supplies after air raids.

1940 Census Provides Much Information For Use By Electric Industry

By Merle Rainey
Statistician, Edison Electric Institute

THE POTENTIAL usefulness of the 1940 Census to the electric industry has been greatly increased by the comprehensive Census of Housing—the first undertaking of its kind in this country—made by the Census Bureau concurrently with the 16th decennial Census of Population and Agriculture. At the same time the information obtained in the Population and Agriculture census was broadened considerably over that secured for earlier census reports, making possible more detailed data and the coverage of much smaller political subdivisions.

As one example of the broadened aspects of the reports, information applying to the larger population areas has been segregated and grouped for these larger units by setting up Metropolitan districts in connection with cities of 50,000 or more, two or more such cities sometimes being in one district. In addition to the central city or cities, the general plan of the Census Bureau has been to include in the district all adjacent and contiguous minor civil divisions (Townships, etc.) having a population of 150 or more per square mile. A recent report shows that almost half of the population of the nation live in the 140 metropolitan districts.

The census enumerations were made as of April 1, 1940, but data other than that of a count or inventory nature such as income, expenditure, wages, rent, etc., cover the calendar year 1939. The complete final results of the 1940 enumeration will not be available in printed form much before the close of 1942 but separate reports for each of the three censuses of Population, Housing and Agriculture are now being issued in a triple series—first, second and third, for each state. These preliminary reports were preceded by mimeographed summary reports, some of which give county and city information in detail. Final first series reports for all states showing the population by counties and minor political subdivisions thereof as well as each incorporated community are available and the final second series reports covering characteristics of the population have been issued for fourteen states, others are being issued currently. For Agriculture both the first and second series reports have been issued for all States. The first series reports cover the number and types of farms, the second series cover farm mortgages, taxes, labor, facilities (including farm electrification data) expenditures, and miscellaneous farm information; fruits, vegetables and minor crops. The third series reports for Agriculture have been issued for about twelve states. These reports on value of farm products, farms classified by major source of income and total value of products as well as the number of farms by size of income.

An example of new and detailed data abstracted from the Census of Agriculture (third series) is shown in Tables I and II covering the number of farms falling within different income groups. The data are presented in detail for each county and should prove quite valuable to electric light and power companies,

DEPARTMENT OF COMMERCE—BUREAU OF THE CENSUS
Sixteenth Census of the United States : 1940
HOUSING SCHEDULE

Your report is required by Act of Congress. This law also makes it unlawful for the Bureau to disclose any facts, including names or identity from your census reports. Only sworn census employees will see your statements. Data collected will be used solely for preparing statistical information concerning the Nation's population, resources, and business activities. Your Census Reports Cannot Be Used for Purposes of Taxation, Regulation, or Investigation.

Block number

I. FOR EACH HOUSEHOLD ENUMERATED ON THE POPULATION SCHEDULE
Items 1 to 6 are copied from the population schedule
1. Population schedule: Sheet No. Line No.
2. Color or race of head
3. Number of persons in this household
4. Live on a farm? Yes ☐ 1; No ☐ 2
5. Home tenure Owned ☐ 1; Rented ☐ 2
6. Value of home or monthly rental $
7. Estimated monthly rental value of nonfarm owner-occupied dwelling unit $

II. FOR EACH DWELLING UNIT NOT ENUMERATED ON THE POPULATION SCHEDULE
8. Is this dwelling unit located on a farm? Yes ☐ 1; No ☐ 2
9. Occupancy status of this dwelling unit: (Ordinary dwelling / Quarters not classified as dwelling)
a. Occupied by nonresident household ☐ 3 ☐ 6
Vacant at time of enumeration:
b. For sale or for rent ☐ 4 ☐ 7
c. Held for occupancy of an absent household ☐ 5 ☐ 8
10. Monthly rental or estimated monthly rental value of nonfarm dwelling unit $

III. FOR EACH RESIDENTIAL STRUCTURE
11. Type of structure in which this dwelling unit is located: (Enter "X" or number of dwelling units in cell)
a. Residential structure without business:
(1) 1-family detached structure ☐
(2) 1-family attached structure ☐
(3) 1-family side-by-side structure ☐
(4) Other 2-family structure ☐
(5) 3 or more family structure (Number of dwelling units)
b. Dwelling unit and business in structure (Number of dwelling units)
c. Other dwelling place (Number of dwelling units)
12. This structure was originally built as:
a. A residential structure with the *same* number of dwelling units ☐ 1
b. A residential structure with a *different* number of dwelling units ☐ 2
c. A nonresidential structure ☐ 3
13. Principal exterior material of this structure:
a. Wood ☐ 1 c. Stucco ☐ 3
b. Brick ☐ 2 d. Other ☐ 4
14. Is this structure in need of major repairs? Yes ☐ 1; No ☐ 2
15. Year this structure was originally built

IV. FOR EACH DWELLING UNIT
16. Number of rooms in this dwelling unit (Exclusive of bathrooms, halls, and pantries)
17. Water supply:
a. Running water within dwelling unit ☐ 1
b. Hand pump within dwelling unit ☐ 2
c. Running water outside dwelling unit (piped) ☐ 3
d. Other outside water supply *within 50 feet* of dwelling unit ☐ 4
e. Other outside water supply *50 feet or more* from dwelling unit ☐ 5
18. Toilet facilities:
a. Flush toilet within structure for *exclusive* use of the household ☐ 1
b. Flush toilet within structure *shared* with other households ☐ 2
c. Chemical or other nonflush toilet within structure ☐ 3
d. Outside toilet or privy ☐ 4
e. No toilet or privy ☐ 5
19. Bathtub or shower with running water:
a. Bathtub or shower within structure for *exclusive* use of the household ☐ 1
b. Bathtub or shower within structure *shared* with other households ☐ 2
c. No bathtub or shower within structure ☐ 3
20. Principal lighting equipment:
a. Electric ☐ 1 c. Kerosene or gasoline ☐ 3
b. Gas ☐ 2 d. Other ☐ 4

V. FOR EACH HOUSEHOLD ENUMERATED ON THE POPULATION SCHEDULE
21. Principal refrigeration equipment:
a. Mechanical refrigerator ☐ 1
b. Ice refrigerator ☐ 2
c. Other (including spring or well house) ☐ 3
d. None ☐ 4
22. Is there a radio in this dwelling unit? Yes ☐ 1; No ☐ 2
23. Principal heating equipment:
a. Steam or hot water system ☐ 1
b. Piped warm air system ☐ 2
c. Pipeless warm air furnace ☐ 3
d. Heating stove ☐ 4
e. Other or none ☐ 5
24. Principal fuel used for heating:
a. Electricity ☐ 1 e. Fuel oil, kerosene or gasoline ☐ 5
b. Gas ☐ 2
c. Coal ☐ 3 f. Other ☐ 6
d. Wood ☐ 4 g. None ☐ 7
25. Principal fuel used for cooking:
a. Electricity ☐ 1 e. Fuel oil, kerosene or gasoline ☐ 5
b. Gas ☐ 2
c. Coal ☐ 3 f. Other ☐ 6
d. Wood ☐ 4 g. None ☐ 7

Items 26 to 32 are not applicable to farm dwellings or to vacant dwellings

VI. FOR EACH NONFARM RENTER-OCCUPIED DWELLING UNIT
26. Is use of furniture included in the monthly rental entered for Item 6? Yes ☐ 1; No ☐ 2
a. If answer is "Yes," what is monthly rental value of this unit without furniture? $
27. Average monthly cost of utilities and fuels paid for by the renter in addition to the monthly rental entered in Item 6: (Utility or fuel / Average monthly cost)
a. Electricity $
b. Gas $
c. Coal, wood, fuel oil, kerosene, gasoline, and other fuel $

VII. FOR EACH NONFARM OWNER-OCCUPIED DWELLING UNIT
For structures without business containing not more than four dwelling units
28. Market value of this property:
a. Owner-occupant's estimate of the market value of this property $
b. Number of dwelling units included in this value
29. Is there a mortgage (or land contract) on this property? Yes ☐ 1; No ☐ 2
30. Present amount of outstanding indebtedness:
a. On first mortgage or land contract $
b. On second mortgage and other junior liens

VIII. FOR EACH FIRST MORTGAGE OR LAND CONTRACT
31. Regular payments required on this first mortgage or land contract:
a. Frequency and amount of regular payments (Enter amount in cell)
(1) Monthly payments of $ each
(2) Quarterly payments of $ each
(3) Semiannual payments of $ each
(4) Annual payments of $ each
(5) Payments at other frequencies totaling $ per year
(6) No regular payments required ☐
b. Do these payments include an amount for reduction of principal? Yes ☐ 1; No ☐ 2
c. Do these payments include real estate taxes? Yes ☐ 1; No ☐ 2
32. What interest rate is now charged on this first mortgage or land contract %
33. Who holds this first mortgage or land contract?
a. Life insurance company ☐ 1
b. Building and loan association ☐ 2
c. Commercial bank or trust company ☐ 3
d. Mutual or mark savings bank ☐ 4
e. Mortgage company ☐ 5
f. Home Owners' Loan Corporation ☐ 6
g. Individual ☐ 7
h. Other ☐ 8

Outline of Information Gathered in Housing Census

TABLE I—NUMBER OF FARMS BY SIZE OF INCOME AND BY STATES—1939-1929

		$10,000 and Over	$6,000 to $9,999	$4,000 to $5,999	$2,500 to $3,999	$1,500 to $2,499	$1,000 to $1,499	$600 to $999	$400 to $599	$250 to $399	Under $250	None or Unclassified	Total All Farms	Number Electrified
Maine	- 1939	401	896	1,426	2,562	4,088	3,888	5,038	4,510	5,219	10,078	875	38,980	21,124
	- 1929	1,563	1,968	2,312	3,923	5,813	5,147	6,276	4,024	3,480	3,868	942	39,006	12,920
New Hampshire	- 1939	200	356	558	1,239	1,795	1,605	2,177	1,949	2,044	4,238	353	16,554	11,184
	- 1929	272	503	838	1,626	2,354	1,962	2,496	1,671	1,809	965	410	14,906	6,160
Vermont	- 1939	170	457	1,294	2,959	4,324	2,965	2,760	1,809	2,016	4,336	492	23,582	12,873
	- 1929	301	994	2,209	4,435	4,912	3,088	3,061	1,932	1,600	2,009	387	24,898	7,565
Massachusetts	- 1939	1,054	1,266	1,882	2,842	3,390	2,717	3,638	3,172	3,871	7,036	1,029	31,897	26,648
	- 1929	1,136	1,514	2,197	3,319	4,037	3,183	3,660	2,312	1,867	1,343	1,030	25,598	16,037
Rhode Island	- 1939	169	182	212	313	367	292	372	313	296	445	63	3,014	2,511
	- 1929	175	232	297	401	456	362	447	302	245	246	159	3,322	1,910
Connecticut	- 1939	640	984	1,431	2,057	2,352	1,565	1,851	1,707	2,312	5,646	618	21,163	17,494
	- 1929	775	1,121	1,616	2,339	2,490	1,853	2,311	1,606	1,380	1,124	610	17,195	9,063
New York	- 1939	2,078	3,587	7,697	18,069	27,707	20,797	20,109	12,888	12,272	24,492	3,542	153,238	106,804
	- 1929	2,733	7,398	15,571	28,860	31,324	19,822	19,431	11,447	8,698	8,274	6,248	159,806	55,019
New Jersey	- 1939	1,194	1,939	2,531	3,261	3,436	2,488	2,637	1,895	1,877	3,652	925	25,835	21,695
	- 1929	1,419	2,346	3,032	4,011	3,990	2,803	2,861	1,596	1,015	783	1,522	25,378	13,441
Pennsylvania	- 1939	1,396	3,032	6,177	13,634	23,045	20,574	24,980	18,387	18,992	35,178	3,632	169,027	98,937
	- 1929	1,658	5,201	10,793	22,736	31,700	25,386	28,332	17,642	12,854	9,932	6,185	172,419	45,638
Ohio	- 1939	1,268	2,499	6,006	17,623	36,532	33,447	36,693	23,910	23,058	46,254	6,474	233,783	143,436
	- 1929	1,418	3,623	9,881	27,521	47,168	35,807	36,235	20,164	14,660	12,458	10,363	219,296	56,740
Indiana	- 1939	1,217	2,796	6,065	14,536	26,876	26,260	31,026	20,306	17,752	34,081	3,644	184,549	95,575
	- 1929	1,424	3,562	8,605	21,484	36,099	30,269	31,467	17,445	12,306	10,489	8,420	181,570	30,335
Illinois	- 1939	3,353	8,683	17,599	32,278	37,241	24,743	25,733	16,826	15,460	27,160	4,363	213,439	87,611
	- 1929	3,400	9,336	20,811	38,364	42,886	29,042	29,097	15,453	10,100	8,154	7,864	214,497	34,231
Michigan	- 1939	849	1,296	3,436	11,120	27,167	29,499	34,044	20,943	18,119	36,584	5,718	187,589	133,095
	- 1929	730	1,995	6,048	19,499	38,020	30,843	29,459	15,098	10,428	9,502	7,750	169,372	34,785
Wisconsin	- 1939	546	1,151	4,365	19,359	47,787	39,104	30,911	13,679	9,587	16,839	3,427	186,735	95,158
	- 1929	737	3,494	13,737	42,293	54,247	26,170	18,308	8,484	5,488	4,310	4,499	181,767	46,565
Minnesota	- 1939	1,065	3,476	10,271	27,571	44,928	32,736	29,096	14,053	10,941	19,940	3,274	197,351	59,838
	- 1929	1,072	4,939	16,265	41,966	49,962	28,314	19,965	9,285	5,745	5,006	4,756	185,255	23,242
Iowa	- 1939	4,791	10,325	20,619	41,884	50,208	29,945	22,267	10,019	7,687	11,662	3,911	213,318	86,786
	- 1929	6,074	14,412	30,651	54,688	49,465	22,310	15,917	7,561	4,670	3,226	5,954	214,928	46,042
Missouri	- 1939	1,323	2,180	4,198	10,899	25,119	33,331	50,720	36,945	32,971	52,212	6,222	256,100	45,355
	- 1929	2,682	3,741	7,395	20,263	44,147	45,249	53,515	29,875	19,944	15,654	13,475	255,940	20,223
North Dakota	- 1939	374	1,077	2,755	7,746	15,409	14,051	13,881	7,017	4,823	5,800	1,029	73,962	11,446
	- 1929	917	4,182	9,885	20,187	20,895	9,821	5,994	2,364	1,303	1,140	1,317	77,975	6,192
South Dakota	- 1939	473	1,012	2,386	6,839	13,430	12,962	13,429	6,974	5,020	8,029	1,930	72,454	12,845
	- 1929	1,511	4,173	9,994	20,339	21,082	9,676	6,330	2,697	1,930	2,602	2,824	83,157	9,070
Nebraska	- 1939	1,913	2,329	4,092	9,926	20,239	21,614	25,057	13,367	8,955	11,238	2,332	121,062	34,886
	- 1929	4,761	7,846	14,995	29,843	33,173	16,449	10,535	4,386	2,554	1,580	3,336	129,458	21,380
Kansas	- 1939	1,561	2,325	4,810	12,106	23,459	23,991	29,877	18,522	14,122	20,894	5,160	156,327	41,549
	- 1929	5,295	7,942	13,481	26,268	36,882	26,091	22,605	10,705	6,823	5,009	5,141	166,042	20,720
Delaware	- 1939	357	302	435	841	1,178	1,058	1,347	951	850	1,486	369	8,994	3,699
	- 1929	156	356	720	1,509	2,147	1,504	1,369	639	442	378	487	9,707	1,561
Maryland	- 1939	422	936	1,898	4,052	6,060	4,857	5,687	4,067	4,151	8,818	1,172	42,110	18,351
	- 1929	616	1,582	3,261	6,147	7,470	6,083	6,705	4,187	3,299	2,285	1,478	43,203	9,145
District of Columbia	- 1939	8	2	2	2	8	7	14	2	7	13	0	65	54
	- 1929	6	4	7	15	11	14	9	9	8	0	21	104	67
Virginia	- 1939	973	1,441	2,145	4,664	11,258	16,274	31,352	29,950	30,802	43,035	2,991	174,885	44,348
	- 1929	1,624	2,305	3,575	7,749	16,941	21,589	40,581	29,198	22,626	17,424	7,128	170,610	13,009
West Virginia	- 1939	210	319	514	1,160	2,878	4,761	12,668	18,103	23,141	33,305	2,223	99,282	26,735
	- 1929	447	656	1,010	2,515	5,960	10,754	21,359	17,015	11,784	7,031	4,120	82,641	5,330
North Carolina	- 1939	497	938	2,459	9,859	32,416	45,493	64,593	43,557	35,357	39,067	4,040	278,276	71,196
	- 1929	470	950	2,392	9,668	36,171	52,134	72,458	43,102	29,328	21,103	12,032	279,708	15,006
South Carolina	- 1939	429	638	1,092	2,737	8,328	15,653	33,477	28,550	21,539	23,914	1,201	137,558	28,764
	- 1929	400	588	1,020	3,631	14,391	25,343	42,270	27,399	18,678	16,664	7,547	157,931	6,067
Georgia	- 1939	699	890	1,475	3,663	10,595	21,438	51,599	50,067	40,885	32,266	2,456	216,033	43,958
	- 1929	714	1,120	2,168	7,283	25,221	41,898	71,228	45,603	27,365	15,868	17,130	255,598	7,499
Florida	- 1939	1,274	916	1,166	2,080	3,840	4,788	8,684	8,582	9,707	17,558	3,653	62,248	16,472
	- 1929	1,314	1,242	1,560	2,864	5,481	6,551	10,961	8,612	7,328	8,328	4,725	58,966	6,489
Kentucky	- 1939	600	1,125	2,144	5,977	13,883	19,937	38,802	39,737	47,206	78,690	4,794	252,894	42,288
	- 1939	922	1,604	3,143	8,559	20,935	28,523	54,368	44,218	37,995	27,549	18,683	246,499	10,691
Tennessee	- 1939	371	775	1,405	3,585	10,077	18,733	46,689	49,146	49,823	62,680	4,363	247,617	35,725
	- 1929	596	1,110	2,254	6,545	20,480	35,371	65,134	46,930	32,225	21,460	13,552	245,657	10,010
Alabama	- 1939	371	496	728	1,441	4,335	10,783	37,185	49,348	54,713	70,212	2,164	231,746	40,519
	- 1929	417	591	1,037	3,541	18,344	40,494	78,272	51,818	32,565	20,916	9,400	257,395	10,505
Mississippi	- 1939	453	567	898	1,728	5,203	14,876	54,707	69,122	70,740	69,547	3,251	291,092	27,670
	- 1929	382	544	1,131	5,338	28,486	59,082	101,666	57,676	29,940	16,965	11,493	312,663	4,792
Arkansas	- 1939	783	1,094	1,512	3,343	8,497	17,817	47,744	49,022	44,411	39,507	2,944	216,674	23,435
	- 1929	703	1,007	1,648	5,822	22,306	40,561	71,739	43,095	25,998	15,161	14,295	242,334	5,121
Louisiana	- 1939	754	999	1,337	2,332	4,799	9,164	29,225	37,080	33,210	28,941	2,226	150,007	17,187
	- 1929	945	1,003	1,403	3,355	12,930	26,316	49,823	30,668	17,318	10,235	7,449	161,445	4,174
Oklahoma	- 1939	790	1,448	3,041	7,395	16,200	20,676	34,846	28,187	26,600	37,157	3,347	179,687	28,280
	- 1929	1,576	3,334	7,136	17,919	33,180	32,725	41,022	24,648	16,356	12,382	13,718	203,866	8,091
Texas	- 1939	4,728	4,971	7,562	16,287	36,351	48,580	82,787	67,789	61,641	78,594	8,782	418,002	93,577
	- 1929	6,336	7,844	13,779	33,463	69,374	79,142	107,549	67,393	45,528	38,368	26,713	495,489	22,854
Montana	- 1939	1,120	1,498	2,549	4,596	6,712	5,494	5,895	3,684	3,189	5,647	1,439	41,823	11,688
	- 1929	1,769	2,595	4,362	7,444	9,246	6,361	5,580	3,037	2,255	2,736	2,110	47,495	3,547
Idaho	- 1939	936	1,504	2,685	5,363	7,870	6,029	6,001	3,551	3,312	4,993	1,419	43,663	26,384
	- 1929	1,867	3,002	4,566	7,653	7,881	5,006	4,567	2,487	1,868	1,434	1,344	41,674	12,809
Wyoming	- 1939	940	810	947	1,635	2,260	1,893	2,028	1,221	1,010	1,721	553	15,018	5,184
	- 1929	1,143	1,199	1,568	2,227	2,653	1,939	1,639	1,012	715	848	868	16,011	1,145
Colorado	- 1939	1,768	1,935	2,532	4,609	6,724	6,017	7,151	4,779	4,328	8,859	2,734	51,436	19,735
	- 1929	3,118	3,682	5,366	8,647	10,338	7,516	7,154	3,988	2,919	3,490	2,758	59,956	9,393
New Mexico	- 1939	687	651	904	1,610	2,514	2,477	3,824	3,507	4,394	12,262	1,275	34,105	6,554
	- 1929	861	929	1,450	2,656	3,609	3,061	4,043	3,381	3,623	5,722	2,069	31,404	1,691
Arizona	- 1939	845	546	567	859	1,172	1,190	2,090	1,992	2,850	5,639	718	18,468	6,031
	- 1929	1,022	802	890	1,191	1,573	1,337	1,906	1,219	1,078	2,135	1,022	14,173	3,671
Utah	- 1939	506	598	932	2,126	3,817	3,521	4,276	2,695	2,461	3,925	586	25,411	17,714
	- 1929	728	1,084	1,792	3,684	5,379	4,126	4,322	2,346	1,731	1,339	628	27,159	15,778
Nevada	- 1939	235	199	236	337	453	346	382	297	318	551	229	3,573	1,812
	- 1929	422	291	367	448	483	306	333	209	181	203	181	3,442	1,139
Washington	- 1939	1,706	2,498	3,365	5,921	8,479	7,646	10,363	8,815	10,018	20,353	2,526	81,686	60,082
	- 1929	3,307	4,345	5,854	8,813	10,678	8,249	9,588	6,262	5,048	5,081	3,679	70,904	34,056
Oregon	- 1939	1,513	1,749	2,405	4,498	6,943	6,483	8,683	6,943	7,373	13,043	2,296	61,829	38,010
	- 1929	1,961	2,482	3,825	6,712	8,800	6,755	7,786	5,232	4,063	4,342	3,195	55,153	18,397
California	- 1939	8,615	7,276	8,956	14,490	18,412	14,362	15,491	10,934	10,187	18,428	5,417	132,558	110,014
	- 1929	12,723	10,979	13,316	18,273	19,834	13,575	13,781	8,727	7,110	10,407	6,951	135,676	85,941

especially since electrification data are also shown in county detail (second series reports).

The final first series, State reports on Housing have been issued for fifteen States. The reports cover "Characteristics of Housing" including occupancy and tenure, state of repair and plumbing, color of occupants, number of persons per room, for urban, rural-non farm and rural farm homes and lighting, running water and toilet facilities for farm homes. Mimeographed reports have been issued showing in some detail, the number of dwelling units, occupancy, state of repair and plumbing facilites and average monthly rental by counties and cities of 10,000 persons or over, and in metropolitan areas for some twenty-five states.

The bi-annual reports covering the Census of Manufactures and Mines and Quarries for 1939 have been pretty well completed. Data in these reports cover value of products, wages and wage earners, fuel consumption and primary power data by industries and by States. Each industry is shown in considerable detail as to production and use statistics. Little county or minor civil divisional data are presented in the reports however, because of disclosure limitations, but some detail is shown covering major industries by industrial areas.

The Census reports on Business cover number of retail stores, gross sales, wage earners, etc. by type of store. Considerable detail are shown by each type, and by States in some detail for metropolitan areas.

In 1920, except for some data on the capacity of generators and electric motors run on purchased power, the Census gave no information relating to electrification. The Agricultural Census for that year, however, summarized and published data on the number of farm homes having "either gas or electricity." In 1930 the primary power data was contained in the manufactures and mining schedules and the agricultural census schedules asked for data on the number of farm dwellings lighted by electricity as of April 1st and the number of farms receiving high line service was shown indirectly by the published reports giving the number of farms "reported as having made expenditures for electric power during 1929." Following the 1930 population census the statistical department of the N.E.L.A. in cooperation with the Department of Commerce undertook the collection of data on the number of

TABLE II—NUMBER OF FARMS BY SIZE OF INCOME FOR THE TOTAL UNITED STATES AND EACH GEOGRAPHIC DIVISION 1939-1929

		$10,000 and Over	$5,000 to $9,999	$4,000 to $4,999	$3,500 to $3,999	$2,500 to $2,499	$1,000 to $1,499	$800 to $999	$600 to $799	$250 to $399	Under $250	Total All Farms	Number Electrified
Number of Farms Reporting Income Within Each Group													
Total United States	- 1939	58,313	88,947	165,679	375,973	680,101	708,917	1,053,575	870,629	821,616	1,145,005	6,096,799	2,032,316
	- 1929	86,587	147,751	291,112	628,006	981,163	937,910	1,245,684	766,118	518,032	397,517	6,288,648	845,356
New England States	- 1939	2,624	4,141	6,842	11,972	16,316	13,032	15,836	13,460	15,758	31,779	135,190	91,834
	- 1929	4,212	6,332	9,489	16,043	19,762	15,565	18,251	11,847	10,351	9,655	124,925	53,655
Middle Atlantic States	- 1939	4,668	8,558	16,405	34,964	54,188	43,859	47,726	33,170	33,141	53,322	348,100	227,436
	- 1929	6,810	14,945	29,398	55,807	67,014	48,011	50,624	30,685	22,567	18,989	357,603	114,098
East North Central States	- 1939	7,033	16,426	37,460	94,916	175,583	153,073	158,427	95,664	83,976	159,918	1,006,095	554,875
	- 1929	7,709	22,010	59,082	149,151	218,420	152,131	144,566	76,644	52,982	44,911	966,502	202,656
West North Central States	- 1939	11,500	22,704	49,101	116,971	192,792	168,630	184,027	106,897	84,519	129,575	1,090,574	292,705
	- 1929	22,312	47,234	102,666	213,524	256,606	155,910	134,861	66,853	42,769	34,217	1,112,755	146,969
South Atlantic States	- 1939	4,769	6,382	11,176	29,058	76,561	114,329	209,421	183,828	166,439	199,463	1,019,451	253,577
	- 1929	5,746	8,803	15,613	41,381	113,683	165,870	266,910	175,764	120,848	89,182	1,058,468	64,173
East South Central States	- 1939	1,795	2,965	5,175	12,701	33,498	64,299	177,383	207,353	222,481	281,129	1,023,349	146,202
	- 1929	2,317	3,849	7,565	23,973	88,245	163,460	299,440	200,642	132,725	86,880	1,062,214	35,998
West South Central States	- 1939	7,055	8,512	13,452	29,357	65,807	96,237	194,572	182,038	165,862	184,199	964,370	162,479
	- 1929	9,560	13,188	23,966	60,559	137,759	178,744	270,133	165,804	105,200	76,046	1,103,134	40,240
Mountain States	- 1939	7,036	7,741	11,342	21,135	31,522	26,967	31,646	21,726	21,862	43,587	233,497	95,102
	- 1929	10,930	13,584	20,360	33,970	41,362	29,650	29,744	17,658	14,389	17,907	241,314	49,173
Pacific States	- 1939	11,833	11,521	14,726	24,899	33,834	28,491	34,537	26,492	27,578	82,024	276,173	208,106
	- 1929	17,991	17,806	22,995	33,798	39,312	28,579	31,155	20,221	16,221	19,830	261,733	138,394
Accumulated Number of Farms Reporting Income Within or Above Size Grouping													
Total United States	- 1939	58,313	147,260	312,939	688,912	1,369,013	2,077,930	3,131,505	4,002,134	4,823,750	5,968,755	6,096,799	2,032,316
	- 1929	86,587	234,338	525,450	1,153,456	2,134,619	3,072,529	4,318,213	5,084,331	5,602,363	5,999,880	6,288,648	845,356
New England States	- 1939	2,624	6,765	13,607	25,579	41,895	54,927	70,763	84,223	99,981	131,760	135,190	91,834
	- 1929	4,212	10,544	20,013	36,056	55,818	71,383	89,634	101,481	111,832	121,387	124,925	53,655
Middle Atlantic States	- 1939	4,668	13,226	29,631	64,595	118,783	162,642	210,368	243,538	276,679	340,001	348,100	227,436
	- 1929	6,810	20,755	50,151	105,958	172,772	220,783	271,407	302,092	324,659	343,648	357,603	114,098
East North Central States	- 1939	7,033	23,458	60,918	155,834	331,417	484,490	642,917	738,581	822,557	982,475	1,006,095	554,875
	- 1929	7,709	29,719	88,801	237,952	456,372	608,503	753,069	829,713	882,695	927,606	966,502	202,656
West North Central States	- 1939	11,500	34,204	83,305	200,276	393,068	561,698	745,725	852,622	937,141	1,066,716	1,090,574	292,705
	- 1929	22,312	69,546	172,212	385,736	641,342	797,252	932,113	998,966	1,041,735	1,075,952	1,112,755	146,969
South Atlantic States	- 1939	4,769	11,151	22,327	51,385	127,946	242,275	451,696	635,525	801,964	1,001,426	1,019,451	253,577
	- 1929	5,746	14,549	30,162	71,543	185,226	351,096	618,006	793,770	914,618	1,003,800	1,058,468	64,173
East South Central States	- 1939	1,795	4,759	9,933	22,634	56,132	120,431	297,814	505,167	727,648	1,008,777	1,023,349	146,202
	- 1929	2,317	6,166	13,731	37,704	125,949	289,399	588,839	789,481	922,206	1,009,086	1,062,214	35,998
West South Central States	- 1939	7,055	15,567	29,019	58,376	124,183	220,420	414,992	597,030	762,192	947,091	964,370	162,479
	- 1929	9,560	22,748	46,714	107,273	245,032	423,776	693,909	859,713	964,913	1,040,959	1,103,134	40,240
Mountain States	- 1939	7,036	14,777	26,119	47,254	78,776	105,743	137,389	159,115	180,977	224,574	233,497	95,102
	- 1929	10,930	24,514	44,874	78,844	120,206	149,856	179,600	197,258	211,647	229,534	241,314	49,173
Pacific States	- 1939	11,833	23,354	38,080	62,979	96,813	125,304	159,841	186,333	213,911	265,935	276,173	208,106
	- 1929	17,991	35,797	58,792	92,590	131,902	160,481	191,636	211,857	228,078	247,908	261,733	138,394

Blocked figures indicate approximate extent of electrification.

wired homes in communities of 2500 persons and over and by counties, based on the number of farm and residential customers. The results of this survey were published in 1932.

The Census Bureau in 1940 gave considerable attention to electric service of American homes. The primary power schedules used for manufacturers and for mines and quarries carried an electric power facilities question. The Census of Agriculture in addition to the question of whether or not the farm dwelling was lighted by electricity has tabulated by counties the number of farms within ¼ mile of a distribution line as well as the source of the power supplied—i.e. whether by power line or by individual home lighting plant. Consideration was given to including a question relating to homes electrified in the 1940 population enumeration. Congress however authorized the Census Bureau to take a Census of Housing, and electric service and facilities were given a prominent place in the schedules used for this purpose. The reproduction of the housing schedule form shows in general the questions which were asked of the head of each family. In the Housing Schedules the enumerator not only collected information of electricity for lighting but for cooking, heating and for refrigerators as well. Data relating to refrigerators will however cover the combination of gas and electric refrigerators.

The final printed first series report on housing are now available for some fifteen states and preliminary releases for twenty-five states on the number of farm dwellings with electric lighting equipment have been issued. The preliminary releases show this by counties and the final printed report by minor civil divisions (precincts, townships, etc.). The outline for the second series reports on housing carries some of the electric items. There is also some possibility that the final reports will present some comparative statistics showing the matter of electric facilities and other economic data such as income, rent, size of families, etc.

Although to date only fragmentary reports have been issued in final form covering some of the 1940 data, the preliminary summaries, the announcements of the Census Bureau and the schedules used all indicate the wide scope of the completed Census. The Edison Electric Institute is preparing from the Census reports, as they are released, a somewhat detailed outline of information which may be helpful in utilizing those data which are directly related to the electric industry. This outline in general will show the scope and extent of the Census data and indicate how it may serve not only those wishing to apply the data to the total industry but to individual service areas as well.

It is ironic that the last three 10-year census enumerations were taken just preceding, and the results made available during times of violently disturbed economic conditions. The 1920 Census data was released during the 1921-1922 depression, the 1930 results were made available at the bottom of the 1932 depression, and the 1940 results are arriving at a time when practically the whole world is engaged in war. However, just as the census data of the past has unquestionably been valuable to industry and company analysts in reaching better understanding of industry problems, the 1940 reports, since they are much more comprehensive and give greater detail, will be proportionately useful in charting the industry trends and the study of its potentialities.

APPENDIX

Outline and General Scope of the 1940 Census Reports

AGRICULTURE

FIRST SERIES BULLETINS—Include State and county data as outlined below:

Farms, farm acreage, and value, by color of operator; farm land according to use; and value of buildings and implements and machinery.

Farms; farm acreage and value of land and buildings; value of buildings and implements and machinery; and cropland harvested, by tenure of operator.

Number of farms; farm acreage and specified values; and cropland harvested, by size of farm.

Specified classes of livestock on farm and ranches, and specified livestock products.

Specified poultry on hand; chicken eggs produced and specified poultry raised and sold; bees on hand, and honey produced.

Acreage and quantity of cereals and grains harvested.

Acreage and production of hay crops and miscellaneous crops harvested.

SECOND SERIES BULLETINS—Include State and county data as outlined below:

Farm mortgage debt and farm taxes levied.

Work off farm, and age, year of occupancy, and residence of farm operator.

Cooperative selling and purchasing and farm expenditures; farm labor for a specified week; and farm machinery and facilities.

Goats and kids; mohair clipped and goats milked; farm slaughter, and purchases and sales of livestock.

Acreage and production of annual legumes, clover and grass seed.

Vegetables harvested for sale; value of farm garden vegetables; and horticultural specialties.

Small fruits harvested; land in tree fruits, nuts and grapes; orchard, citrus, and nut trees and grapevines; and production; maple syrup and sugar made.

(The above First and Second Series Bulletins are now available by individual State reports from the Superintendent of Documents, Washington, D. C. at prices ranging from 10 to 35 cents. These two series will be combined and issued in cloth bindings to be known as Volume I—Agriculture. The bound volumes will be divided and issued separately in six parts; (1) New England, Middle Atlantic and East North Central States; (2) West North Central States; (3) South Atlantic States; (4) East South Central States; (5) West South Central States, and (6) Mountain and Pacific States.)

THIRD SERIES BULLETINS—Include State and county data as outlined below:

Value of specified livestock on farms; and value of specified livestock products and crops harvested.

Value of farm products sold, traded, or used by farm households and value of products, by source of income.

Farms classified by total value of farm products sold, traded, or used by farm households.

Farms reporting and value of farm products sold, traded, or used by farm households, classified by major source of income.

Farms reporting and value of farm products sold, traded, or used by farm households, classified by total value of products.

(Third final Series reports are now available for fifteen states. Reports covering other states are being issued periodically. On completion of the individual state bulletins they will be bound and issued as Volume II—Agriculture).

Irrigation Bulletins—A bulletin will be issued (covering one or more of the 20 irrigation States) presenting data on water supply and quantity used, water rights, type of enterprise, area irrigated, physical works, investment, financing, and cost of maintenance and operation.

Drainage Bulletins—A State bulletin (for each of the 36 drainage States) presents data on the class of enterprise, land drained, investment, financing, type of drainage works, and cost of operation and maintenance.

State Irrigation Maps—in colors showing drainage basin boundaries are also to be made available.

POPULATION

FIRST SERIES REPORTS—Separate reports for each State showing population of the State, the counties by minor civil divisions, details for metropolitan districts and by census tract areas as outlined below:

Population of State—urban and rural.

Population of incorporated places of 10,000 or more from earliest census.

Area and population of counties, urban and rural.

Population of counties by minor civil divisions.

Population of incorporated and urban places.

Population of incorporated places of 5,000 or more by wards.

Population of metropolitan districts.

Population of larger cities by census tracts.

(Now available for each State—5 to 10 cents each. A bound volume will be made available for all States—Volume I—Population—Number of Inhabitants).

SECOND SERIES REPORTS—Characteristics of the population including age, sex, race, nativity, citizenship, school attendance, employment status, class of worker, and occupation and industry statistics, by State, counties and cities as outlined below:

Composition of the population.

Age, race, and sex.

Persons 14 years old and over, by employment status, class of worker, major occupation group, industry group, and sex.

Foreign-born white, by country of birth, by

(*Continued on page* 35)

Field Testing of Generator Insulation*

NEED for a practical as well as a reliable nondestructive test that will determine the condition of generator insulation has long been recognized by the industry. Simple methods now in general use, the high voltage proof test and the insulation resistance test, do not accurately or positively disclose the overall condition of windings, indicate the degree of deterioration, or necessarily locate weak spots. This lack of suitable insulation tests has been emphasized recently by the return to service of a number of machines either after long shutdown periods during the depression years or from standby service to low pressure elements used in connection with topping units; in these cases knowledge of insulation conditions is vital.

As a result of this situation the Edison Electric Institute Electrical Equipment Committee undertook active work on the problem in 1935.[1] In 1937 a special subject committee was appointed on "Generator Insulation and Testing," with the ultimate object of developing a reliable test procedure for determining the condition of generator insulation. The investigation has been carried out by various member companies of the EEI and others in the industry interested in the problem, under the guidance of the subject committee. Close contact has also been maintained with the manufacturers who have made many valuable suggestions, assisted in testing, and given aid in analyzing data.

The study is by no means complete and this paper should not be construed as a final report with definite conclusions, but rather as a progress report on an investigation still under way.

Present Status of Insulation Testing

Present testing practice in this country was surveyed in 1938, revealing a wide variation in testing methods and procedure. High voltage proof testing which consists merely of the stressing of the insulation by the application of an alternating potential according to the rules in the AIEE standards is generally used for acceptance tests for new and repaired machines. There is no general agreement as to advisability of routine proof testing nor magnitude nor frequency when such tests are applied to machines in service. Insulation resistance testing is a common practice though generally a definite routine is not followed. In the past the procedure often has consisted of a "crank and read" type of measurement. Today, increasing recognition is being given the fact that insulation resistance values may be misleading unless careful account is taken of the many factors which may affect the results. No definite practice seems to be established regarding other methods of test, such as high voltage d-c resistance, dielectric loss or power factor tests.

Comparatively few operating companies maintain regular schedules of periodic insulation testing, from which records may be obtained to serve as a guide of the progressive condition of the insulation. Such special tests as are made are carried out usually after a machine winding has been repaired or an inspection indicates it to be in questionable condition.

Foreign practice in this respect also indicates a lack of uniformity. In some countries, notably Germany and Switzerland, experiments have been made with dielectric loss measurements, and it is felt there that this type of measurement has some promise of value as an index of changing insulation condition. A few experiments have made use of a recording instrument giving a curve of dielectric losses versus time during machine operation. It has been suggested that this method may give a definite index of changing conditions within the insulation. The method has not received broad use.

Scope of Work

Originally it was the objective of the subject committee to conduct destructive and nondestructive tests on insulation of machines about to be scrapped, rewound, or repaired and to develop from these a workable nondestructive method of determining insulation condition. Valuable information has been obtained from these tests but inasmuch as many of the data consist of "spot" readings taken under a variety of conditions, it has not been possible to correlate all of the data nor to draw definite conclusions. Real need for periodic and standardized measurements has become apparent. The scope of the investigations has been broadened to include and encourage the collection of periodic nondestructive test data on machines in service. By this means information is being accumulated on all classes of insulation, from the old to the new.

Insulation characteristics of both armature and field windings are undergoing investigation. Table I summarizes the machines tested or under test. The machine ratings vary from 1,500 kva, 2,700 volts to 200,000 kva, 16,500 volts.

TABLE I

Type of Test	*Number of Machines*
Insulation resistance	106
Power factor of insulation	27
Ionization	8
Voltage strength a-c	21
Voltage strength a-c versus d-c.	6*

* Includes 2-2.3 kv motors.

The subject committee, recognizing the need for uniform practice in insulation testing, has prepared a guide to be used in making such tests. Copies of this are available to the industry through EEI headquarters.

D-C Insulation Resistance

Although d-c insulation resistance is among the most commonly used methods for testing the insulation of electrical apparatus, records obtained have been baffling of interpretation, and the factors which affect the results are to some extent unknown and often unappreciated. The fundamental that different types of insulating materials may have different volume resistances is obvious; but there are other variables which affect successive tests on a given piece of apparatus and cause widely varying results.

Tests have been directed to establish the manner in which the insulation resistance varies with

(*a*) Differences in insulation materials and structures.
(*b*) Duration of voltage application.
(*c*) Existing charge in windings.
(*d*) Insulation temperature.
(*e*) Test voltage magnitude.
(*f*) Insulation moisture content.
(*g*) Previous operating condition of the generator.
(*h*) Various types of winding damage or deterioration.

These investigations have confirmed findings obtained in similar experiments made by others and have gone somewhat

* Summary of investigation in progress by Subject Committee on Generation Insulation and Testing, Electrical Equipment Committee, EEI. Paper originally presented at A.I.E.E. winter convention, Philadelphia, Jan. 27-31, 1941.

[1] For all numbered references, see list at end of paper.

further in extending the limits to which such tests have been conducted in the field.

Instruments

Experiments made so far have indicated that any one of several types of test instruments will give satisfactory insulation resistance results. Commercial forms of insulation resistance testers perform satisfactorily provided they are calibrated periodically and tested to assure their voltage output is proper. The maximum voltage at which measurements have been made with these instruments is 5,000 volts, d-c. Motor driven devices or other constant voltage generators are necessary for taking long time insulation resistance curves. Hand operated units may be used for short time readings.

The voltmeter method may be used with fair accurancy if the insulation resistance is less than 10 megohms. To insure accuracy of readings a high resistance voltmeter should be used.

Considerable success has been attained with electronic rectifier sets having d-c outputs from 100 to 5,000 volts and with dry cell battery sets up to 1,500 volts. These use a voltmeter and a microammeter for measurements which permit calculation of insulation resistance. They must be carefully shielded and guarded.

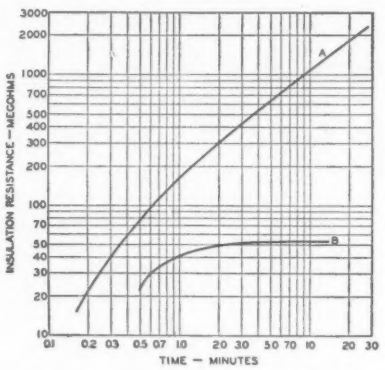
Higher voltages may be obtained from Kenotron test sets. Tests may be carried to any reasonable limit of voltage with this type of equipment, though 5,000 volts appears to be the present limit for sets portable by hand. In all rectifier sets it is essential that a steady supply of voltage be available to prevent fluctuation in charging current to the generator winding capacitance, an automatic voltage regulator being used if necessary.

Where protective resistors are used in test instruments their effect on the voltage magnitude applied to the insulation should be carefully taken into account.

Duration of Voltage Application

While many insulation resistance measurements have been taken by the "crank and read" method, Wieseman[2] and others have shown that the insulation resistance of a winding varies with duration of voltage application. Insulation resistance of a dry winding in good condition may continue to increase for as long as a day or more with the test voltage applied continuously at a steady value. Normally an approximately final value, which is termed "apparent insulation resistance" may be reached after 10 to 15 minutes. Insulation resistance after 30 seconds to 60 seconds may be as little as 10 per cent to 20 per cent of the 15-minute reading.

In Figure 1 insulation resistance versus time curves, commonly referred to as dielectric absorption curves, are shown for different conditions of generator insulation. Curve *A* is a good example of the effects of "bone dry" and clean insulation on the final value of insulation resistance and on the shape of the dielectric absorption curve. This curve represents an unusually high insulation resistance for a machine whose rating is 200,000 kva, 16,500 volts, in one stator winding. Curve *B* was taken on an 18,750-kva, 13,200-volt generator which had been exposed to varying degrees of atmospheric humidity for several years. Considering size alone this smaller unit would be expected to have a higher insulation resistance than the larger unit. However, the insulation conditions are such that the reverse is the case. Leakage resistance effects predominate and the curve flattens rapidly between the 30-second and the 3-minute readings.



A—200,000 kva, single-barrel generator, 16.5 kv, 60 cycles, 1,800 rpm (insulation dry)

B—18,750 kva, single-barrel generator, 13.2 kv, 60 cycles, 1,800 rpm (insulation moist)

Fig. 1—Armature-winding insulation resistance versus time.

Information contained in curves of this nature discloses the reason for at least one difficulty in past attempts to correlate insulation resistance readings, for it is obvious that "spot readings" made without regard to definite time of voltage application can give widely varying results.

Many dielectric absorption curves have been collected. While it is believed that these data give information as to dryness and cleanliness of winding, spot curves have not disclosed a positive relation between insulation resistance and insulation condition. Therefore, periodic curves are being taken and the behavior of the dielectric absorption factor over a long period is being observed and analyzed.

Effect of Existing Charge on Winding

Comparative values of winding insulation resistance are markedly affected by residual charges retained in a winding. For this reason windings should be grounded and discharged for at least ten minutes before applying insulation resistance tests.

Insulation Temperature

Tests have indicated that the insulation resistance of windings is affected greatly by temperature. The most marked effect occurs in class *A* windings but even in class *B* insulation structures, the insulation resistance may vary as much as 10 to 1 for a winding temperature change from approximately 25 degrees centigrade to 75 degrees centigrade, the insulation resistance being lower at the higher temperature.

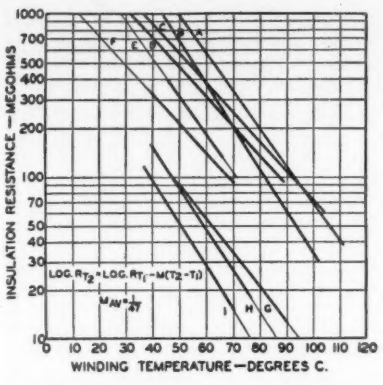
It is desirable that insulation resistance readings be taken at temperatures as close to 75 degrees centigrade as possible, to secure an indication of resistance at operating temperatures, eliminating the effect of humidity and requiring minimum temperature correction.

Figure 2 gives the results of field tests undertaken with the objective of establishing factors which will permit readings taken at one temperature to be transferred to a lower or higher temperature. The results so far indicate two families of curves, with similar characteristics of insulation resistance versus temperature in each group. The curves may be represented by the formula:

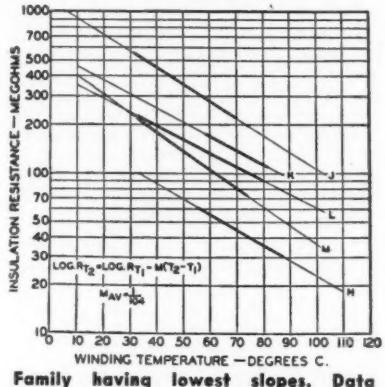
$\log R_{t2} = \log R_{t1} - M(t_2 - t_1)$

where R_{t2} and t_2 are the unknown resistance and temperature at which the resistance is desired, R_{t1} and t_1 are the measured resistance and the related winding temperature and M is a constant equal to the reciprocal of change in temperature for $\log R = 1$. Insulation resistance doubles for each 14 degree centigrade reduction in winding temperature for the curve whose $M = 1/47$, and doubles for each 31 degree centigrade reduction for the curve whose $M = 1/104$.

Although it might be assumed that the two families of curves bear definite relation to insulation class, this is not the case. Machines with both class *A* and class *B* windings appear in each group.



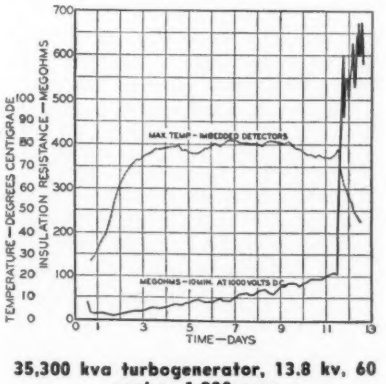
Family having more common slope. Data taken at 500 to 20,000 volts after ten minutes



Family having lowest slopes. Data taken at 1,000 to 8,000 volts after one to ten minutes

Fig. 2—Insulation resistance versus temperature.

Operating conditions apparently have a large effect on these characteristics, for data indicate that even after years of operation changes in the value of M for a given machine may occur from year to year. This is evident from figure 3 in which the curves having an average value for $M = 1/44$ were taken in 1938 shortly after a new generator was placed in service. The curves having an average value for $M = 1/60$ were taken on this same machine approximately two years later. The machine had been operated about 72 per cent of the elapsed time at an average of 95 per cent of rated capacity and had been run for several days, well loaded, before the last test. It is apparent, therefore that the value of M may vary for a given machine but it is not known definitely whether this variation is due to differences in moisture or volatile matter content in the insulation, or whether it is due to some aging or curing action which has been under way during the many continuous hours of high load operation. It is believed that moisture is the most likely cause of the variation.


TEMPERATURE — DEGREES CENTIGRADE
INSULATION RESISTANCE — MEGOHMS
MAX. TEMP. - IMBEDDED DETECTORS
MEGOHMS - 10 MIN. AT 1000 VOLTS D.C.
TIME — DAYS

35,300 kva turbogenerator, 13.8 kv, 60 cycles, 1,800 rpm

Fig. 4—Change in ten-minute insulation resistance with time during generator dry-out.

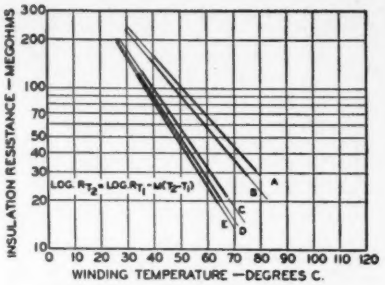
While extrapolation of the curves of Figure 3 appears to meet in a point at low temperatures other data indicate parallelism or a meeting at high temperatures. The reason for and meaning of these variations are not known.

No definite formula applicable to all machines, or even to the same machine under various conditions, can be given at this time for the relation of insulation resistance to temperature. Two readings taken at the same date on a machine will establish a curve for that machine for a definite condition of the insulation. A change in slope of an insulation resistance - temperature curve indicates a change in the insulation condition.

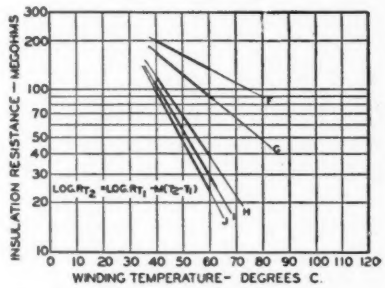
Effect of Moisture Content

Accurate insulation resistance data are very useful in determining the progress of drying machine insulation. It is customary to dry a machine until the insulation resistance readings at constant temperature approach a constant value when plotted with regard to time. When drying out, the attainment of a constant insulation resistance at a constant temperature is a better indication of dryness than is the attainment of some previously selected value.

Figure 4 indicates the variation of insulation resistance of a new turbo-generator whose winding is being dried. Each point of insulation resistance was taken after ten minutes application of test voltage. The insulation resistance dropped rapidly as the winding temperature increased and then recovered as the moisture was driven from the insulation. When the test was terminated, the insulation resistance rose rapidly as the winding temperature decreased.



68,750 kva turbogenerator, 13.2 kv, 60 cycles, 1,800 rmp
Data taken following acceptance test run
A Insulation resistance at 10 min. — M = 1/53
B Insulation resistance at 4 min. — M = 1/50
C Insulation resistance at 1 min. — M = 1/41
D Insulation resistance at 30 sec. — M = 1/39
E Insulation resistance at 15 sec. — M = 1/38
Avg. — M = 1/44

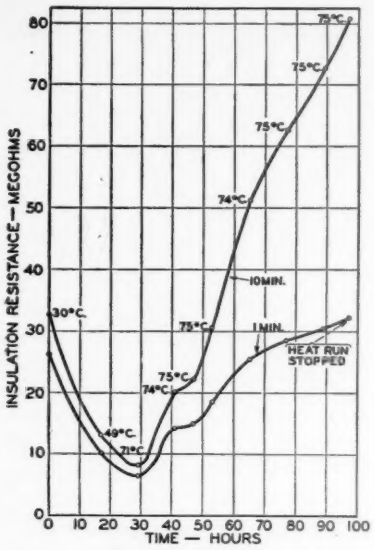


Data taken following about two years of base-load service
F Insulation resistance at 10 min. — M = 1/115
G Insulation resistance at 4 min. — M = 1/74
H Insulation resistance at 1 min. — M = 1/41
I Insulation resistance at 30 sec. — M = 1/36
J Insulation resistance at 15 sec. — M = 1/34
Avg. — M = 1/60

Fig. 3—Insulation resistance versus temperature for different periods of voltage application.

Figure 5 gives another method of plotting similar data as taken on the initial dry-out run of a 37,500-kva water-wheel generator and illustrates the value of the one- and ten-minute readings in obtaining a clear picture of the conditions during machine dry-out. It will be noted that as the run progressed the separation between the curves increased, indicating an effective drying of the insulation and the resulting increase of absorption effect in the dielectric.

The degree of moisture content in the outer layers of generator winding insulation has a very marked effect on the insulation resistance. A machine which has



37,500 kva hydrogenerator, 13.3 kv, 25 cycles, 100 rpm

Fig. 5—Change in one-minute and ten-minute insulation resistance with time during generator dry-out.

been running regularly will generally have a much higher insulation resistance at room temperature than the same machine after being idle for several weeks in a humid atmosphere. A relatively low insulation resistance resulting from exposure to moist air does not necessarily mean that the insulation is inferior or that the machine is not safe for operation. If the insulation resistance is still reasonably high for the machine in question as shown by reference to periodic test data it may be returned to service and the moisture will be driven from its windings by the increased machine temperature.

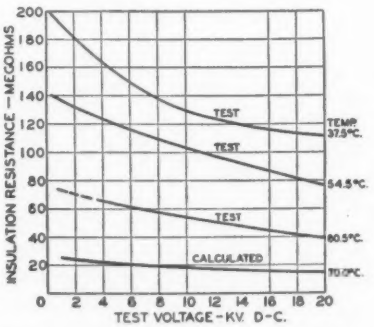
An interesting case, illustrating the use of insulation resistance curves in determining the effects of moisture, concerns a machine which had been subjected to flood waters. After dry-out, the insulation resistance increased to a satisfactory though not a high value and the machine was placed in service. The unit was operated with cooling air supplied through a spray system equipped with baffles for removing water from the air before it reached the generator. Later, after fairly continuous service, the generator was found to have low insulation resistance. The cooling air was suspected of carrying moisture into the machine and preventing thorough drying. The unit was operated under test load for two hours using relatively dry turbine room air for generator cooling to learn of its effect on insulation resistance. Curves *A* and *B* of figure 6 show the insulation resistance results before and after this change in cooling air. As a result of these tests the unit, and several others in the same plant were equipped with surface coolers and a closed ventilating system, with improvement in insulation resistance as shown by curve *C* of Figure 6.

Spray type air washers have not caused similar trouble at certain other locations where the same type of tests were made on generators whose windings had not been submerged.

Effect of Test-Voltage Magnitude

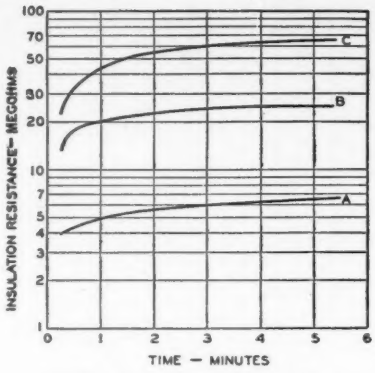
Insulation resistance measurements at 75 degrees centigrade of dry insulation in good condition will be affected very little by wide variations in test voltage. The effect appears to increase somewhat at lower temperatures as will be noted on Figure 7. Windings having high leakage due to moisture or dirt, or other types of deterioration, may show a more pronounced reduction in insulation resistance as the test voltage is increased.

Results of complete tests on two machines, have indicated there may be some merit in comparisons between insulation resistance measurements at two different d-c voltages, at the same winding temperature. A 25,000-kw generator winding section was given a dielectric absorption test at 2.5 kv and at 15 kv d-c. The coils were then punctured on a 60-cycle high potential test and the insulation resistance values at the two voltages were again taken. The first test gave a ratio of approximately 2 to 1 with the 2,500-volt measurement being higher. The second test gave an insulation resistance ratio of approximately 6 to 1 after the insulation had been punctured. This test was repeated on another coil group and the ratio changed from approximately 2 to 1 to a ratio of approximately 4½ to 1.



30,000 kw, turbo-generator, 6.6 kv, 25 cycles, 1,500 rpm

Fig. 7—Insulation resistance versus test voltage at different winding temperatures.



25,000 kva generator, 13.2 kv, 60 cycles, 1,800 rpm
Tests made at 500 and 1,000 volts dc. Winding temperature 74 degrees centigrade
A—After using a water spray air washer. Cooling air humidity — 78 percent
B—After using turbine-room air at approximately 38 percent humidity during a two-hour load run made immediately after test A
C—After using a closed ventilation system and surface coolers for about one month

Fig. 6—Armature-winding insulation resistance versus time.

The stator winding of a 30,000-kv synchronous condenser was found in very bad condition on visual inspection in a plant where two machines of the some rating and age were operating. The insulation resistance of the winding which had to be replaced was found to have a ratio of more than 7 to 1 between the 2,500-volt and 20,000-volt tests, respectively. The insulation resistance of the other machine was found to have a relation of approximately 1.25 to 1 for the 500-volt and 10,000-volt tests and 1.2 to 1 for the 2,500-volt and 10,000-volt tests, respectively. The winding of this machine appeared to be in excellent condition.

While sufficient data have not been accumulated to permit final conclusions, they do indicate that a wide difference in insulation values determined by low and high voltage tests should lead one to suspect irregularities in the insulation. Efforts at conducting voltage tests under staged conditions by mechanical damage have met with poor success because of the difficulty of keeping reductions in the dielectric strength of armature bar insulation under control.

Insulation Power Factor

Power factor testing of generator windings is not in common use. Experiments have been made, however, to determine whether some test of this type

may be useful and practical. The 60-cycle power factor of generator insulation has been studied for different winding temperatures and impressed voltages.

Equipment

Any well constructed and properly shielded power factor measuring equipment is satisfactory. Circuits of the test instruments must be thoroughly shielded and guarded to prevent interference from other energized equipment. Use of the ordinary wattmeter, voltmeter, and ammeter is not likely to give satisfactory results. Suitable commercial measuring equipment is available from several sources. A testing supply of ample capacity to furnish the charging current at the measurement voltage should be used.

Park and Skeats[4] have shown that generator winding capacitance can be determined fairly accurately by use of the formula $C = K_c \frac{\text{MVA}}{\sqrt{kv(1+0.08\ \text{kv})}}$ microfarads per phase.

The constant K_c has the following values:

	K_c	*Assumed Peripheral Speed Ft/Min*
Solid round rotors	0.0187	22,000
Salient-pole generators without amortisseurs	0.0347	10,000
Salient-pole generators without amortisseurs	0.0317	11,000

C is approximately inversely proportional to peripheral speed.

Capacitance of connecting cables must be added if included in the test.

Charging current at high voltage may be 25 per cent to 100 per cent above that determined by the capacitance constant alone, depending upon the extent of the corona losses, which vary with the impressed voltage.

Results

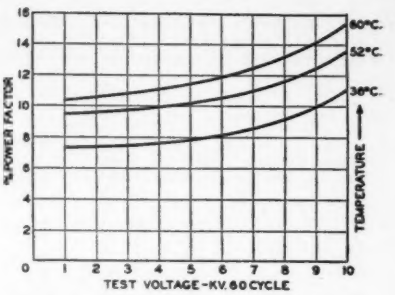
Power factor measurements on machine insulation may be affected by many conditions, most of which are similar to those outlined for d-c insulation resistance. The time of voltage application appears to have little effect on winding power factor unless it causes heating within the insulation. Winding temperature and moisture content will have a pronounced effect, and winding capacitance is, of course, an important factor. Voltage magnitude has an effect on power factor causing it to increase as the voltage is increased over the normal test range.

Insulation power factor should be nearly constant at each voltage below the ionization value.

Figure 8 shows the typical variations of winding power factor with different values of applied alternating voltage at different temperatures.

Power factor measurements have thus far produced little data which may be used to indicate insulation condition, other than moisture content.

No experiments have been conducted on dielectric loss characteristics by the subject committee. European engineers have had some success with this method, particularly as applied to control of manufacturing processes. It has received little attention as a means for supervising the insulation characteristics of an operating machine.



30,000 kw, turbo-generator, 6.6 kv, 25 cycles, 1,500 rpm

Fig. 8—Insulation power factor versus test voltage at different winding temperatures.

Ionization Measurements

Both qualitative and quantitative ionization measurements[5] have been investigated to determine whether such measurements can be used to detect insulation irregularities in generator insulation. The quantitative tests were designed to obtain a characteristic showing the relative magnitudes of ionization discharge from a generator winding as the applied a-c voltage was varied, and to determine whether this might have any relation to the physical condition of the insulation or to its dielectric strength. Qualitative tests were designed to locate ionization points in the winding on the supposition that ionization would be present at weak points in the insulation.

Apparatus used for the qualitative tests

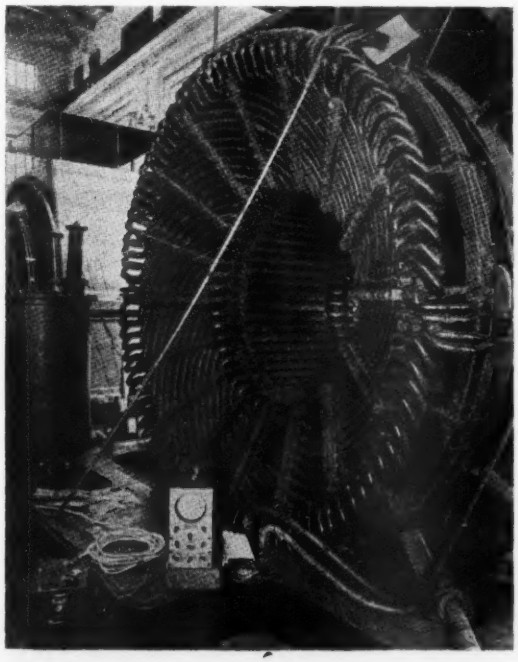


Fig. 9—(Left) Ionization detection apparatus ready for use.

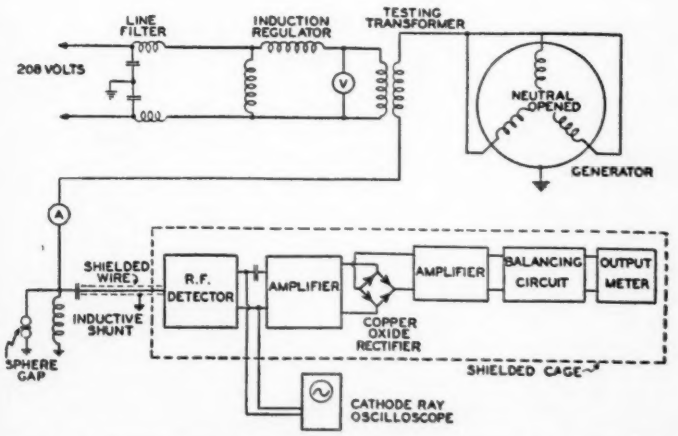


Fig. 10—Connections of apparatus for measurement of ionization intensity in generator windings.

TABLE II—SUMMARY OF GENERATOR WINDING INSULATION TESTS* 1935-1940

Rating (Kva)	Voltage	Speed (RPM)	Armature Insulation Age (Yrs.)	Armature Insulation Type	Armature-Insulation Resistance Megohms	Time (Min.)	Voltage	Temp. (°C)	Armature-Insulation Power Factor Per Cent P.F.	Temp. (°C)	Voltage (Kv)	High-Voltage Breakdown (Kv) Armature 60 Cy.
12,000	11,400	750	16	B	2,000	6	500	20				35
12,000	11,400	750	15	B	1,150	10	500	20	11	20	6.6	45
20,000	6,600	1,500	22	B	300	10	500	22	6.7	22	3.8	39
20,000	6,600	1,500	22	B	350	10	500	22	6.5	22	3.8	43
14,000	7,800	720	30	A	310/185	10	500/5,000	20	11	20	4.5	46
					54/35	10	500/5,000	47				
68,750	13,800	1,800	0	B	200	10	8,000	36				
			2	B	208	10	8,000	36				
33,000	11,000	360	15	B	38/28	10	1,000/5,000	56				
55,000	11,000	360	5	B	285	20	5,000	48				
00,000	16,500	1,800	7	B	2,200	25	1,000	22				
15,000	13,200	94.7	2		36	10	1,000	22				26 (Before rewinding)
18,750	6,600	112.5	16	A	33	10	8,000	32	10	35	2.5	
									13	35	8	.8 (Min.) 21.4 (avg. of 18 coils)
30,000	12,000	1,800	10	B	32/26	10	5,000/15,000	28				
30,000	9,250	1,500	0	B	700/500	10	4,000/9,000	30	7.5/9.0	30	4/10	
3,500	12,000	1,200	27	A	16and17	1	1,000	6	22 to 29 (Arm & Fld.)	1	3.5	22.5 Min. (avg.—51.5 kv) (2 units—same rating)
28,600	13,800	1,800	11	B	74	10	470					8 to 14 (3 coils tested)
23,750	11,000	1,200	21	B	40,000/coil	3	500	11	6.7 (Avg.)	11	6	17 to 35 (1/3 of coils)
23,750	11,000	1,200	12	B	460	1	470	21	3.2	35	0.5	
3,500	2,300	1,800	9	B	1,000	1	470	21				
4,000	2,300	1,800	25	B	200	1	470	21				
8,000	11,000	1,800	23	B	340	1	470	21	8.9	31	0.5	
20,000	11,000	1,800	14	B	195	1	470	21	6.7	23	0.5	
23,750	11,000	1,200	14	B	955	1	470	21	3.5	50	0.5	
23,750	11,000	1,200	14	B	345	1	470	21	9.8	46	0.5	
43,750	11,000	1,800	10	B	140	1	470	21	5.4	24	0.5	
10,000	11,000	94	26	B	475/275	10	1,000	36/60				
10,000	11,000	94	25	B	670	10	1,000	63				
13,750	11,000	94	15	B	265	10	1,000	69				
10,000	11,000	94	15	B	235	10	1,000	60				
10,000	11,000	94	27	B	845/157	10	1,000	28/70				
12,000	11,000	116	26	B	311	10	1,000	69				
12,000	11,000	116	25	B	136	10	1,000	73				
12,000	11,000	94	24	B	540	10	1,000	29				
15,000	13,200	94.7	2	B	36	10	1,000	22				26 (Before rewinding two years earlier)
15,000	13,200	94.7	14	B	35	1	1,000	80				
12,500	13,200	1,800	11	B	1,270/200	10	1,000	41/79				
12,500	13,200	1,800	13	B	820/164	10	1,000	44/73				
30,000	12,000	1,200	6	B	10/7		4,000/12,000	(Room)	10	(Room)	10	14 (Old winding replaced in 1939)
			0	B	37/31		4,000/12,000	(Room)	8	(Room)	10	(New winding)
1,500	2,700	1,200	36	A	65	10	1,000	20	20	20	3	3.5
2,500	2,300	3,600	13	B	150/phase	2	1,000	20	18	20	3	6.5
27 777	13,200	1,800		B	1,500/phase	10	2,500	40	4.3	53	10	25 (38°C)
27,777	13,200	1,800		B					6.2	53	10	18 (53°C)
30,000	13,600	720	11	B	2,200/1,900	10	2,500/10,000	25				
30,000	13,600	720	11	B	6,500/2,500 (Ph-1)	10	2,500/10,000	30				26.3 (Avg.)
					5,800/2,700/800 (Ph-2)	10	2,500/10,000/20,000	30				
30,000	13,600	720	0	B	400 (1-Ph)	10	2,500	20				
					920 (All Ph)	10	2,500	20				
58,824	13,800	3,600		B	950	10	1,000	28				
30,000	13,270	300		B	1,000	10	2,500					
14,000	6,000	720	27	A	135/105	10	1,000/8,000	28	22/15	28	6	
1,500	11,000	375	0	B	1,200	5	25,000	30				
80,000	14,400	1,800	0	B	100	1	1,000	70				
					350/200	Final	1,000/10,000	33				
80,000	14,400	1,800	3	B	80	10	1,000	43				
80,000	1,400	800	2	B	19	10	1,000	45				
18,750	13,200	1,800	24	B	99/12	10	500	32/63				
18,750	13,200	800	24	B	125/25	10	500	28/74				
25,000	13,200	1,800	18	B	520/50	10	500	37/75				
31,250	13,800	1,800	3	B	900/190	10	500	34/72				
30,000	6,600	1,500	22	B	170/110	10	1,000/20,000	37	10	52	5	32.7 (Avg.)
24,000	13,800	1,800	21	B	100	10	1,000	47				
23,500	13,800	720	3	B	950	10	1,000	34				
58,800	13,800	3,600	0	B	1,500/2,100	10/35	1,000	27				
188,500	13,800	1,800/1,200	13	B	15/19	10	1,000	33				
188,400	13,800	1 800	13	B	40/21	10	1,000	25/43				
160,000	11 400	1,500	12	B	560 & 660	10	1,000	27	(Machine has two independent windings)			
24,000	13,200	1,800	31	B	330	10	1,000	21				
23,500	13,800	720	3	B	120	10	1,000	35				
35,000	11,400	1,500	17	B	1,000	10	1,000	42				
35,300	13,800	1,800	0	B	460	10	500	50				

* Insulation resistance data on 40 machines not listed because of lack of full rating information.

is shown in Figure 9. Equipment for the quantitative measurements was connected as indicated in Figure 10. Complete shielding of the apparatus is necessary, and even then external disturbances due to radiations from energized equipment nearby are bothersome. For the quantitative tests the radiations in the radio frequency range were amplified, rectified, and measured by a sensitive d-c instrument. The measurements were relative only and not of any definite figure in amperes of ionization current.

Results of Qualitative Measurements

The qualitative ionization tests determined not only the impressed voltage at which ionization began, but were reasonably successful in determining the locations at which more severe ionization was present. On 6.6-kv and 11.4-kv generators having old winding designs varying in insulation structure from 100 per cent class *B* to all class *A* construction in the slot section, the voltage at which ionization was noted varied from about 1,000 volts to approximately 7,000 volts. The machine on which ionization was detected at 7,000 volts and 21 degrees centigrade, was a 7.8-kv class *A* insulated unit. When this winding temperature was raised to 47 degrees centigrade, ionization could be detected at about 5,000 volts.

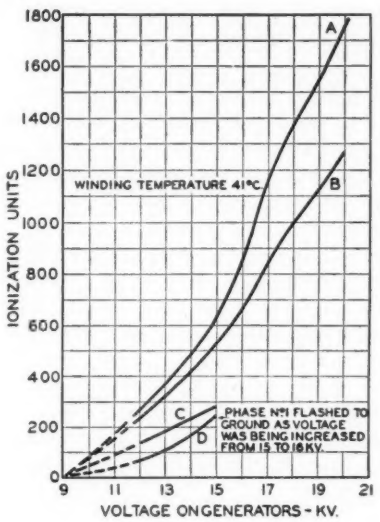
Ionization was detected at 1,000 volts on a 6.6-kv machine with mica insulation at a point where the coil passed through an air duct at the center of the stator winding. Though signs of corona pitting were expected in the insulation and heavy paper protective covering actually no evidence of such damage was found.

Where an aerial was used for detection, the only radiations due to ionization which were picked up in the slot sections of the stators were at air ducts and at the outer edges of the stator iron, even though the voltage was raised to more than two times machine rated voltage. This may be explained partially by the shielding effect that the stator conductors receive in the slot sections. Ionization was detected at the end turns of all machines tested by this method, at voltages varying from 25 per cent to 50 per cent of machine rated voltage.

An attempt was made with the search aerial to locate points where intentional damage had been inflicted to the insulation of various generators, by bruising the insulation with hammer blows, by cracking the insulation in bending, and by cutting into the insulation structure with a knife. The qualitative measurements gave no clear indication that ionization had increased or that it developed at a lower voltage.

Results of Quantitative Measurements

Quantitative ionization tests were made to determine the relation of ionization discharge with change in impressed voltage and to determine whether the rate of change could be used to detect insulation damage or deterioration. Figure 11 shows the curves obtained on a class *A* insulated machine for all three phases, two phases separately, and for a section of another phase winding whose insulation had been intentionally damaged as previously described. It was thought that the curve would show a step type characteristic giving sudden increases of ionization units at increasingly rapid steps as the impressed voltage was increased. This characteristic does seem to be partially realized in the curves for the two separate phase tests, though not to the degree anticipated. The results on the winding section which had been damaged were somewhat surprising since the winding failed to ground as the voltage was approaching 16 kv. This is only 1,000 volts above the highest voltage at which a measurement of ionization units was made. The curve shape gives no indication of approaching failure.



14,000 kw vertical turbogenerator, 7.8 kv, 60 cycles, 720 rpm
A—Phase 3
B—Phase 2
C—Phases 2 and 3 and section of phase 1
D—Section of phase 1

Fig. 11—Ionization intensity measurements on each phase of a generator winding.

High-Voltage Tests—A-C and D-C

A survey of coil insulation strength was made on a number of machines where the machine was being removed permanently from service or where the winding was to be replaced. The work consisted of a-c high potential tests, to breakdown, on different phases and different coil sections and, in some cases, was supplemented by tests using d-c voltage from Kenotron testing equipment. These tests were made in conjunction with other measurements on winding sections as found and on coil sections which had been subjected to various types of mechanical damage intentionally inflicted. Special attention was also given to determination of the relative a-c and d-c strength of winding insulation.

Effect of Age on Dielectric Strength

Generator armature winding insulation strengths were found remarkably high even after 20 to 30 years of service, as will be noted by reference to Table II. There were occasional failures at voltages less than twice normal rated voltage attributable to mechanical injury which had developed in the insulation and which could not be seen until the winding was disassembled. Most of the breakdown voltages were far in excess of the voltage specified for new machines in the AIEE Standards. A 6.6-kv generator with 1915 class *B* insulation failed at the end turns at approximately 6½ times rated terminal voltage on several tests. This is the machine on which ionization was detected in the slot section at the air duct with an impressed potential of only 1,000 volts. It was impossible to obtain a failure on one of the armature bars after the end-turn brackets had been disassembled, though the voltage was raised momentarily to 72 kv and held at 68 kv (over 10 times normal) for a period of 5 minutes. This case is exceptional and is not intended to convey the thought that armature bar insulation has this safety factor as a general thing.

Rotor Dielectric Tests

Ten turbogenerator fields were tested to destruction, with breakdown voltages varying from 1 to 5.5 kv. Six of the fields punctured at values between 1 and 2 kv which indicates that, in order to prevent undue stress, routine field testing should preferably be done with a 500-volt source rather than with a 1,000-volt source.

Dielectric Strength—A-C Versus D-C

Numerous tests have been made to determine the relative strengths of generator insulation as determined by breakdown voltage using a-c and d-c test equipment. An established ratio between the two types of tests will permit use of low capacity d-c testing equipment on large armature windings.

Such tests were made by selecting a group of four to six coils, each at different locations, around the periphery of the stator for each type of test. Unusually low breakdown strengths were disregarded as being caused by abnormal weaknesses in the coil. Experiments made to date have given the following results:

TABLE III

Machine	*Average Insulation Breakdown Strength* A-C Voltage (RMS) Kv	D-C Voltage Kv	Ratio D-C/A-C (RMS)
2.3-kv motor	13.2	20.8	1.6
2.3-kv motor	11.7	21.0	1.8
13.8-kv, 30-mva synchronous condenser	28.3	38.5	1.46
6.6-kv, 30-mva turbo-generator	34.0	46.7	1.38

Similar tests have been performed in the laboratory on a group of spare generator coils, no end-turn supports were used. The slot sections of the coil were grounded carefully by clamping them into metal troughs. The average 60-cycle break-down was 65 kv. The d-c value varied from 150 to 175 kv. The ratio is approximately 2.5, which approximates values to be expected in cable insulations. It is thought the test set-up, by reducing ionization, may have more nearly represented a cable structure than it did a generator coil structure.

Relation Between Insulation Resistance and Dielectric Strength

Since the ultimate objective of this investigation has been to determine a test method or a group of tests which could be used to determine the true quality of generator insulation with regard to its ability to withstand high voltage, much time has been spent in attempting to find a relation between dielectric strength as determined by a-c and d-c breakdown and various d-c insulation resistance measurements made at non-destructive voltages. In the early work, insulation resistance magnitudes were compared with 60-cycle breakdown strength on many coils. The investigation has been enlarged to include comparisons between insulation strength determined by a-c breakdown tests with dielectric absorption curve shapes and variations in insulation resistance characteristics at widely varying values of d-c voltage. Comparative insulation resistance and a-c breakdown tests have also been made under many conditions of deliberate mechanical damage to the insulation.

At present, no claim can be made that the ultimate objective has been attained. Comparisons between single insulation resistance measurements and dielectric strength seem to have little or no value and, under certain circumstances, the insulation resistance at moderate d-c voltages has been found to increase after the winding has been punctured on an a-c high potential test.

Location of Dielectric Failures

Stator winding insulation failures on breakdown tests occurred frequently at the end-turns. In some machines several coils were punctured, using both a-c and d-c, without a single failure occurring in the slot section. As indicated in Table II the insulation strengths varied widely but invariably if a number of coils were tested, it was found that the weakest portion of the winding structure was at the end-turns.

Most end-turn failures occurred from the winding to the supporting brackets which always involved a flash through a short air gap. The insulation recovery after these failures was such that insulation resistance measurements did not detect any change in the winding characteristics. The failures which occurred in the slot sections appeared at the end of the slot or at the edge of an air duct in the stator iron. It is possible that ionization or swelling of the insulation at these points caused damages which reduced the dielectric strength but we have not been able to confirm the predominating cause. Very few machines have shown severe distress as a result of corona. In the few cases where effects of corona have been noted, the class *A* outer layer only has been affected. There has been no case where direct injury to mica insulation due to corona action has been discovered.

Conclusions

1. The industry will obtain increased value from its insulation testing if the known causes for variations in the results are carefully taken into account.

2. Insulation resistance varies widely with type and speed of machine, type and condition of winding, degree of cleanliness, temperature, moisture content, and extent of d-c charge on the winding. "Spot" readings, particularly, may be misleading unless carefully corrected for various factors affecting the reading. However, periodic readings may indicate a trend of the general conditions of the insulation.

3. There is at present insufficient data to permit accurate correction of insulation resistance readings for all factors affecting these readings.

4. Slopes of the resistance-time curves may be of value as an indicator of insulation condition. They are satisfactory indices of excessive moisture content in the insulation.

5. Insulation resistance-time curves are extremely useful to indicate the progress of winding dry-out.

6. Comparisons of insulation resistance-time curves taken at widely different d-c voltages may prove of value in determining insulation condition.

7. The voltage effect on winding insulation resistance appears to be greater as the winding temperature is reduced, or as the moisture content is increased.

8. Power factor tests have given little indication of value in locating faults or incipient faults in generator windings. However, power factor measurements may prove to be an indicator of the trend of the general condition of the insulation including moisture content in a given machine if records are kept of periodic readings.

9. Sixty-cycle ionization tests have given no indication of value in predicting generator insulation condition or locating weak spots in windings.

10. D-c/a-c (rms) relative dielectric strength of generator insulation appears to approach $\sqrt{2}$. Additional tests must be made to establish this more accurately.

11. Dielectric strengths of old armature windings have been found to be generally high.

12. The end-turns of old generator windings appear to be weaker dielectrically than the slot sections.

13. Preferably, field windings should not be stressed to more than 500 volts d-c in routine testing.

REFERENCES

1. Progress Report—INVESTIGATION OF TEST METHODS FOR DETERMINING OPERATING CONDITION OF GENERATOR INSULATION, H. R. Stewart. Electrical Equipment Committee, EEI, Eighth Meeting, Chicago, Illinois, October 7 and 8, 1935. (Note: The foregoing item is out of print, but a supplementary mimeographed pamphlet, "Guides for Initial, Periodic, and Experimental Testing of Generator Insulation" is available in a limited quantity.)

(*Continued on page* 40)

MKB Movie Geared to War Conditions

UTILITIES in every part of the country report enthusiastic audiences and highly satisfactory results at every showing of "It Happened in the Kitchen," the new full color talking motion picture recently released by The Modern Kitchen Bureau.

Each showing of the picture achieves two results, utility executives find. First, the picture gives homemakers the latest facts on how electrical appliances provide increased nutrition, the most efficient use of appliances, how to plan kitchens to save time and steps, and other timely data to help them meet the demands of the war period; second, the film helps to build up a backlog of desire for electrical appliances, that will be ready to flow through the floodgates when there will again be plenty of appliances to sell.

Customers of today and those of tomorrow are equally suitable audiences, reports coming in to the Bureau indicate. Women's clubs, parent-teacher associations, church groups, all form ready-made audiences of real importance to the utility; and the home economics classes of local schools learn from this movie the facts about the all-electric kitchen that will make them highly profitable customers tomorrow.

Some Typical Reports

Here are some reports of typical showings of "It Happened in the Kitchen," selected from those coming in every day to the Bureau.

West Penn Power Company, Pittsburgh, showed the film to a high school home economics class and reported: "Instructor and students found the film very helpful and stimulating in connection with their work on kitchen planning and electrical equipment. Students are to prepare written reports of their reactions, which their instructor will forward to us," writes Harry Restofski, Sales Promotion Manager. And when the film was presented at a dealer cooking school, he reported: "Women seemed to enjoy the film very much, and the dealer thought the showing very worthwhile."

"The showing resulted in the sale of an all-electric kitchen," when the movie was shown to an audience of six kitchen modernization prospects of Boston Edison Company.

Buffalo Niagara and Eastern Power Corporation, Buffalo, has made more than 30 showings of the film to date. Additional requests are continually being received from women's clubs and professional groups. "In all cases, the audience reaction has been excellent," the company reports.

Georgia Power Company, Atlanta, has made showings to audiences of as many as 600 women. "Following the showing of the film, small groups of ladies in attendance gathered to discuss the possibility of rearranging the equipment in their individual kitchens. This would indicate that the film definitely stimulates some action on the part of those in attendance," O. M. Jackson, Sales Promotion Manager, writes.

Among other utilities reporting successful showings of "It Happened in the Kitchen" are Consumers Power Company, Jackson, Michigan; Alabama Power Company, Birmingham, Ala.; Gulf States Utilities Company, Beaumont, Texas, and Nebraska Power Company, Omaha.

"It Happened in the Kitchen," a 16 mm. Kodachrome talking motion picture, can be shown on any of the portable projectors now in use in thousands of schools, to both small and large audiences.

The Modern Kitchen Bureau is offering a complete variety of booklets and other aids for use in building audiences for each showing, and for follow-up work afterwards.

A purchase print of the film is offered at $220.00, which price includes such supplementary material as black and white photographs from the film for publicity and advertising use, suggestions for building audiences, and blueprints of major kitchens featured for distribution. Inspection prints of the picture are available at a charge of $5.00; which is applied against cost of the film if purchased.

A practical plan book giving full details of the picture, and suggestions for its best use, is available from The Modern Kitchen Bureau, 420 Lexington Avenue, New York City.

One of the opening scenes from the new full-color, talking motion picture "It Happened in the Kitchen." Here you see the Joneses . . . a typical American family in their typical old-fashioned kitchen.

Believe it or not, this used to be an old-fashioned kitchen . . . but you wouldn't know it now! The story of how the Jones family transformed their kitchen is told in the film "It Happened in the Kitchen."

New Engineering Reports of the Joint D&R Subcommittee

TWO new Engineering Reports of the Joint Subcommittee on Development and Research—EEI-Bell System, have just been printed in pamphlet form. Both of these reports deal with certain aspects of the noise frequency coordination of power and telephone circuits. Brief descriptions of the reports follow:

Engineering Report No. 45—Frequency Weighting for Message Circuit Noise*

The problem of the evaluation of telephone circuit noise may be divided into two parts: (1) the measurement of noise in such a way that noises having equal interfering effects are measured as equal, and (2) the interpretation of the measured magnitudes in terms which are useful in telephone engineering. The attention of the Joint Subcommittee on Development and Research has been directed in the past toward both phases of the problem, considerations involved in both the measurement of noise and the interpretation of the results having been covered in Engineering Report No. 25.

Frequency weighting is of primary importance in the measurement phase of the noise evaluation problem. Frequency weightings for noise measurement are dependent upon the hearing mechanism, the telephone mechanism, including line, transmitter and receiver characteristics, as well as upon other more intangible factors such as the frequency composition and magnitude of room noise, the manner of using telephone instruments, and the general experience of the telephone user.

Frequency weightings applicable to the telephone plant as of 1935 were given in Engineering Report No. 32. Considerable progress has been made since that time in the science of telephony, and part of this progress has affected to a major degree the telephone mechanism, particularly the instruments used by the telephone subscriber in receiving and transmitting speech.

The frequency responses of the new telephone sets which are being moved into the telephone plant are considerably more uniform than those of their predecessors. This would suggest that certain related changes should be made in the frequency response of devices designed for the objective measurement of noise on telephone circuits and in telephone receivers. Judgment tests of the effects of noise on telephone transmission when the new instruments are used have shown, in fact, that the objective noise measuring devices could be improved by changes in frequency response. Therefore, the devices which were suitable for measuring noise, when instruments of the type used in and before 1935 comprised the subscriber plant, are becoming less suitable as the subscriber plant is changed to take advantage of the advances that have been made in telephone set performance.

Changes in frequency response also involve consideration of the resulting changes in the numerical magnitude of measured noise and of the meaning of these magnitudes as related to interfering effect, i.e., relation of interfering effect to numerical measured magnitudes with the weightings being compared.

The purpose of this report is to describe a new weighting which will be more suitable than the present standard weighting for use in measuring telephone circuit noise on that part of the telephone plant in which the subscriber facilities consist of the new instruments.

From the point of view of interpretation of measured results it is intended only to show that the noise magnitudes, which would be obtained with improved measuring devices embodying the new weightings just mentioned, could be used within the general framework of the method already established for relating noise magnitude to noise transmission impairment.

*Engineering Report No. 46**—Susceptiveness of Subscriber Station Sets*

Information on the inductive susceptiveness of subscriber station apparatus is frequently required in connection with noise induction problems in the exchange telephone plant. Data of this character available to the field heretofore have been limited chiefly to sets employing type 337 transmitters and type 144 receivers. The large number of type 557 receivers now in the plant and the introduction of newer types of instruments, induction coils and ringers have emphasized the need for more comprehensive information on this subject. The results of an investigation undertaken to meet this need are summarized in this report.

The report deals with sets arranged for grounded signaling with one terminal of the ringer or relay grounded permanently or during the talking period. It does not include tube sets or those relay sets in which the ringer or relay is grounded only during the signaling period. The unbalances due to stations with non-grounded ringers are small and the receiver noise resulting from the action of longitudinal voltages on these unbalances is usually negligible. The manner in which receiver noise currents and metallic-circuit currents in the line are set up by grounded signaling branches is treated in some detail in Engineering Report No. 6 and is considered in the present report only briefly in connection with the case of more than one set on a line.

The material in the report has been arranged primarily with a view toward facilitating its use in practical problems. A comparison of the susceptiveness of a number of sets is given for two rather general conditions with regard to the frequency composition of noise to ground. Working tables intended to facilitate calculations of receiver noise from analyses of noise to ground in specific problems are also included for the more commonly employed sets. A series of curves of single-frequency ratios of receiver currents (in microamperes) per volt to ground constitutes the basic test data. These curves are more complete than the supplementary tables, so far as the types of sets and instrument combinations are concerned, and provide information on receiver currents due to set unbalances for cases not covered in the working tables.

To permit direct comparisons of the susceptiveness of sets with the older and newer types of instruments, the values of receiver noise (in db) given in the tables for types 557 and HA1 receivers have been adjusted approximately to the present scale of noise magnitudes (in db) for the type 144 receiver, i.e., equal values of db for noise producing approximately equal interfering effects in the three receivers. The 144 receiver noise scale was chosen for this purpose since the present receiver noise transmission impairments are related to noise magnitudes in this type of receiver. Conversion of the adjusted db values to noise units may be made on the basis employed for the 144 receiver (0 db = 14 noise units).

* EEI Publication I-7 — Price 20c to members; 50c to non-members.

** EEI Publication I-8 — Price 60c to members; $1.50 to non-members.

1940 Census

(*Continued from page 24*)

counties, and for cities of 10,000 to 100,000: 1940.

Indians, Chinese, and Japanese, by sex, for counties, and for cities of 10,000 to 100,000.

Composition of the rural-nonfarm population.

Composition of the rural-farm population.

Race and age, by sex, with rural-farm population, for minor civil divisions.

(Final Second Series Reports are now available for the following States: Maine, New Hampshire, Vermont, Iowa, South Dakota, Delaware, West Virginia, Mississippi, Montana, Idaho, Wyoming, New Mexico, Arizona, Utah, and Nevada. When completed for all States, the reports will be bound under one (or more) cover known as Volume II—Population, Characteristics of the Population).

HOUSING

FIRST SERIES REPORTS — Present limited tabulations of housing data for the State, counties, incorporated places of 1,000 inhabitants or more and minor civil divisions. Subjects presented for all areas are the total number of dwelling units classified by occupancy and tenure, color of occupants, number of persons per room, state of repair, and plumbing equipment; additional subjects shown for urban and rural-nonfarm areas include the number of residential structures, the average monthly rent or rental value of dwelling units, and the mortgage status of owner-occupied nonfarm units; and for rural-farm areas additional information is shown concerning electric lighting, running water, and toilet facilities. Tables presented are as follows:

Characteristics of housing for State, urban and rural: 1940.

Urban and rural-nonfarm housing, by contract or estimated monthly rent and mortgage status, for the State: 1940.

Rural-farm housing, by lighting equipment, running water, and toilet facilities, for the State: 1940.

Characteristics of housing for urban places, and for wards of cities of 10,000 inhabitants or more: 1940.

Characteristics of housing for counties, by minor civil divisions and incorporated places of 1,000 inhabitants or more: 1940.

Characteristics of rural-farm housing for counties, by minor civil divisions: 1940.

Characteristics of housing for metropolitan districts, by minor civil divisions: 1940.

(Final First Series printed reports on Housing are available for the following States: Maine, New Hampshire, Vermont, Rhode Island, North Dakota, South Dakota, Delaware, Mississippi, Arkansas, Montana, Idaho, Wyoming, New Mexico, Arizona, Utah and Nevada and a supplemental report of Block Statistics for Wilmington, Delaware.

(The completed series will be bound and made available as Volume I—Housing—Data for small areas).

Related reports—Supplements to the first series of Housing bulletins present similar statistics for blocks in each city that in 1930 had 50,000 inhabitants or more. In the supplementary reports for cities, the block data are summarized for census tracts in tracted cities and for wards, or equivalent subdivisions, in untracted cities.

SECOND SERIES REPORTS—Contain more detailed statistics for the State, for urban, rural-nonfarm, and rural-farm areas in the State, for counties, for rural-nonfarm and rural-farm parts of counties, for urban places, and for metropolitan districts. Additional topics covered by the second series will include size of household, value or rent of farm dwelling units as well as nonfarm dwelling units, type of structure, exterior material, year built, number of rooms, lighting equipment, water supply, toilet facilities, bathtub or shower, radio, refrigeration equipment, cooking fuel, heating equipment, heating equipment, heating fuel; and for tenant-occupied nonfarm dwelling units, gross monthly rent and inclusion of furniture in rent. The more significant items will be shown separately for the various occupancy, tenure, and color groups.

THIRD SERIES and other Housing Reports not yet issued.

Commercial Committees Realigned for Victory Effort—General Power Conference in March

Revamping of EEI commercial committee activities has been completed in accordance with the policy, announced in last month's BULLETIN, which has the broad objective of stimulating service phases of utility company operation as a vital contribution to the war effort.

The over-all policy group will be the General Commercial Committee. Reporting to it will be committees on Lighting, Industrial Power and Heating, Appliance Maintenance, Home Service, Dealer, Electric Water Heating, Farm Utilization, Wiring and Post War Planning. Two committees were discontinued—the Home Lighting Equipment Sales and Household Appliance Sales and two new committees were added—one on Appliance Maintenance and one on Post War Planning. The Air Conditioning Committee will be inactive. However, it will prepare and publish the statistical report for installations in 1941 in accordance with standard practice.

* * *

R. E. Fisher, Vice-President, Pacific Gas & Electric Company, San Francisco, and Chairman of the General Commercial Committee, has announced a General Power Conference to be scheduled the week of March 23. Monday will be Committee Day. There will be all "general" sessions on Tuesday, Wednesday and Thursday morning, March 24-26. The Conference will close with a formal luncheon meeting.

Commercial men of the industry have momentous problems in the industrial and agricultural fields along with important adjustments to make in supporting the Victory program. Electric service is in a key position in the battle-front and likewise the home-front. Electrical manufacturers and others interested in electric power supply are invited to attend the meetings.

Buy DEFENSE SAVINGS BONDS and STAMPS

Domestic Electric Appliances

(*Continued from page* 16)

used by the various large appliances in domestic service last year and the results since 1920 are shown graphically on the chart. Because it is impossible to distinguish between appliances bought by farmers and those bought by the general public, the classification "domestic service," as used here, has been enlarged to include all current supplied to all non-farm homes and for all farm uses except irrigation pumping. It must not be confused with "residential" service, which does not include customers on "distinct rural rates."

Due to the continued increase in the efficiency of the newest units, the average effective kilowatthour per refrigerator has been reduced from 344 in 1940 to 318 in 1941—*W. M. C.*

Surge Phenomena

A RECENT publication of the British and Allied Industries Research Association entitled "Surge Phenomena" contains much valuable information on the general subject of surges on power lines. The publication is a 400 page, handsomely printed book, and represents seven years' research on this subject for the Central Electricity Board.

Of the 25 chapters, five deal with the study of lightning, its nature, magnitude of currents and potentials in lightning flashes, various methods of measurement employed and results obtained by investigators in many parts of the world. Six chapters deal with surge propagation on power lines, in which theoretical analyses are supplmented by surge propagation tests on 33 kv and 132 kv lines. Four chapters deal with the surge voltage distribution in transformers and three chapters discuss the effects of surges on insulation. The last seven chapters deal with various methods of protecting lines and equipment against damage from surges. The characteristics are given for a new type of surge filter developed during the course of the investigation, referred to as the E.R.A. surge filter, and the results of tests on this and other protective devices are presented. A fairly extensive bibliography of literature on the general subject of surges is included.

The book contains much valuable information in its numerous charts and tables, and includes many oscillographic records showing the behavior of surge currents and potentials. The clarity of presentation is augmented by summarizing statements at the beginning of each chapter, with conclusions at the end of each chapter.

This publication may be obtained from the British Electrical and Allied Industries Research Association, 15, Savoy Street, London, W.C. 2. The price is £2 10s, net.—*H. W.*

Albert Lieberman

ALBERT LIEBERMAN, President of Southwestern Gas and Electric Company, died January 16, at Texarkana Hospital, Texarkana, Texas, following an illness of a few hours.

Mr. Lieberman was born September 30, 1886, in LaFayette County, Missouri. His career in the electric industry in the Southwest began in Mammoth Springs, Arkansas, where he served as an executive for a small hydro-electric company. He later went to Walnut Ridge, Arkansas, where he became associated with the Morrison-McCall interests of St. Louis, and for ten years had charge of their properties in Arkansas, Oklahoma, and Missouri. During his association with Morrison & McCall, he acquired many utility properties, some of which are at this time owned and operated by Southwestern Gas and Electric Company. He then went to McAlester, Oklahoma, for a short time as Vice-President and General Manager of the McAlester Gas and Coke Company.

Early in 1926 Mr. Lieberman came to Southwestern Gas and Electric Company as Assistant to the President. In 1928 he was elected Vice-President and General Manager, and in March, 1929, was elected President in which capacity he had served until his untimely death.

During his career with Southwestern Gas and Electric Company, Mr. Lieberman saw the company grow from a small group of isolated properties to an efficient, well integrated electric system, serving approximately 30,000 square miles. He also saw the development of the world's largest oil field which is located within the boundaries served by his company. It was under his direction that the 45,000-kw Arsenal Hill generating station at Shreveport came into being.

The last outstanding highlight of his career was his authorization for the construction of the highline from Overton, Texas, to a point east of Ashdown, Arkansas, and another line from Ashdown to Weleetka, Oklahoma, in connection with the serving of the Aluminum plant near Hot Springs, Arkansas, and other defense industries within this area.

Fred W. Herbert

Fred W. Herbert, former Accounting Director of the N.E.L.A., died January 18 in New York at the age of 76, after several weeks of illness.

Widely known and liked throughout the industry, Mr. Herbert became associated with the N.E.L.A. in 1919, organizing the Service Department and serving as Accounting Sponsor. During the early years of his connection with the Association, he devoted much time to the establishment of a Uniform Classification of Accounts for Electric Utilities which was adopted by 29 state regulatory commissions. He worked closely with the Accounting Committees of the N.E.L.A. and at the time of his retirement in 1932 to enter private practice, he was Accounting Director of the Association.

Mr. Herbert was born in Vermont but early in life moved with his parents to Denver. He received his early education in that city and in the engineering department of Washington University, St. Louis, Mo. After leaving college he became connected with utility work in an accounting and financial capacity. He served as accountant and also in an official capacity with the Denver Union Water Company, the Denver Consolidated Gas Company and subsidiary plants in the early electrical plant development.

Retiring temporarily from the utility field he devoted a few years as manager of a bond company and in the private practice of accounting. When the Public Service Commission of Colorado was established in 1914, Mr. Herbert was appointed the first chief accountant and statistician of the Commission. He remained with the Commission until 1919, when he came to the N.E.L.A.

Mr. Herbert was one of the pioneers in advancing and promoting the theory of retirement reserve as opposed to the old theory of depreciation, and was credited with systematizing the accounting departments of a number of large electrical concerns throughout the United States. Surviving are his widow, Mrs. Frances Hanscome Herbert; three daughters, Mrs. John F. Winchester (Kathryn Herbert, editor of the EEI Rate Book) of New York; Mrs. Grove P. Griffith of Belmont, Mass., and Mrs. Flynn Andrew of Great Neck, N. Y., and a sister, Mrs. Joseph A. Long of Berkeley, Calif.

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MS-1—Suggestions for Specifications for Standard Dial Constants for Alternating Current Watthour Meters (8/40)	.10	.10
MS-2—Suggestions for Specifications for Coordinated and Standardized Low Voltage Metering Current Transformers (8/40)	.10	.10
TD-1—Suggestions for Specifications for Bolts and Nuts (5/37)	.20	.20
TD-2—Suggestions for Specifications for Anchor Rods (6/39)	.10	10
TD-3—Suggestions for Specifications for Lag Screws (10/38)	.10	.10
TD-4—Suggestions for Specifications for Eye Bolts (6/39)	.10	.10
TD-5—Suggestions for Specifications for Eyenuts and Eyelets (4/41)	.10	.10
TD-6—Suggestions for Specifications for Steel Crossarm Braces (5/40)	.10	.10
TD-8—Suggestions for Specifications for Straight Tinned Copper Connectors (10/40)	.10	.10
TD-10—Suggestions for Specifications for Rolled Steel Washers (5/40)	10.	.10
TD-51—Suggestions for Specifications for Low and Medium Voltage Pin-Type Insulators (5/37)	.10	.10
TD-61—Suggestions for Specifications for Type "A" Untreated Douglas Fir Crossarms (11/40)	.10	.10
TD-62—Suggestions for Specifications for Type "B" Untreated Douglas Fir Crossarms (11/40)	.10	.10
TD-71—Suggestions for Specifications for Insulator and Pin Threads and Gauges (5/37)	.10	.10

General Sales Committees

	Members	Non Members
Air Conditioning		
Air Conditioning Installations, 1941	$1.00	$1.00
Air Conditioning Installations, 1940 *(Air conditioning installation reports also available for 1934-35-36)*	1.00	1.00
Lighting		
Typical Promotional Programs — Home Lighting Equipment (1941)	.35	.35
Power		
G-4—Electric Metal-Melting Furnaces (1/40)	.80	2.00
F-11—Electrification of Oil Refineries (10/38)	.30	.75
C-13 Steam and Electrical Requirements of Hotels (12/35)	.30	(members only)
C-2 Steam and Electrical Requirements of Office Building (4/35)	.30	.75
Power Sales Manual (1941)	3.50	5.00
Water Heating		
I-5 Standardization of Electric Water Heating Equipment (10/41)	.20	.50

National Promotional Programs

Commercial Cooking		
Commercial Cooking Survey, 1941	$ .25	.25
Sales Training Manual—Commercial Electric Cooking, 1941	1-4 copies	$1.50
	5-14 "	1.25
	15 or more	1.00
Domestic Cooking		
Meals Go Modern Electrically	.10	.10
Electric Kitchens		
It Can Happen In Your Kitchen	$2.80 per 100	
She Runs a Beauty Parlor in Her Kitchen	.04	.04
I Just Had My Face Lifted Electrically	.04	.04
How to Plan a Modern All-Electric Kitchen	$2.00 per 100	
The Principles of Kitchen Planning	.25	.25
Films		
"It Happened In The Kitchen"—16 mm. full color, talking motion picture. Including complete promotional program	$212 plus excise tax	
"Sales Training"—Series of 10 films and 10 discussion manuals. Five on basic selling and five on product selling, i.e., refrigerators, ranges, roasters, water heaters and laundry equipment. Price on meter basis for entire series.	$125 to $275	
Lighting		
Better Light—Better Sight— Better Production	$2.50C	$2.50C
Better Light—Better Sight— Better Living	2.50C	2.50C
Better Light—Better Sight— Better Sales	2.50C	2.50C
Priceless Eyes	4.50C	4.50C
Films		
"Time to Relight"—(Commercial) sound slide 15 minutes, 85 pictures	$10.00 film & disc	
"Light Up—Step Up"—(Industrial) sound slide 15 minutes, 75 pictures	10.00 " " "	
"You Can Do Something About It"—(Home) sound slide, 15 minutes, 95 pictures	10.00 " " "	
	($22.50 for set of three above films)	
"Light Makes Sight"—16 mm. full color, talking motion picture	$135.00 plus excise tax	
(Additional prints)	$ 80.00 plus excise tax	
Wiring		
Rewiring for Commercial and Industrial Buildings	.25	.25
Handbook of Interior Wiring Design—1937	.50	.50
Basic Factors of Adequate Wiring —1939	.25	.25
Covered Neutral Cable Helps Sell Adequate Home Wiring—1939	.25	.25
Commercial Building Re-wiring Market—1939	.35	.35
(Price on above three books as a group is 60c per set)		
Films		
Commercial Re-Wiring — lantern slides	Set $17.50	
Home Wiring—lantern slides	Set 35.00	

Miscellaneous, Reference Books, Etc.

	Members	Non Members
Code for Electricity Meters (1941)	1.60	2.00
Electrical Metermen's Handbook (1940)	2.40	3.60
Good Radio Reception (1937)	100	4.00
	1000	25.00
	3000	60.00
	5000	95.00
Objective Type Rates, 1933-1936	.80	2.00
Power Sales Manual (1941)	3.50	5.00
Rate Book, 1941	10.00	25.00
Rewiring for Commercial and Industrial Buildings (1941)	.25	.25
Sales Training Manual—Commercial Electric Cooking (1941)	$1.50	$1.50
Storm Loading and Strength of Wood Pole Lines and a Study of Wind Gusts (1936)	2.00	5.00

Periodicals

	Members	Non Members
Better Light—Better Sight News (9 issues yearly)	.75	.75
Edison Electric Institute Bulletin (Monthly)	2.00	2.00
Modern Kitchen Bureau News (Bi-Monthly)	Free	Free
Rural Electrification Exchange (Quarterly)	.60	1.00

RECENT EEI PUBLICATIONS

SECOND REPORT—STANDARDS FOR DISTRIBUTION TRANSFORMERS

EEI. Pub. I-9. A report of the Joint Committee of the Edison Electric Institute and National Electrical Manufacturers Association on Standards for Distribution Transformers, 18 pages. Price 25c to members and their employees; 60c to non-members in the U.S.A.; 70c to foreign countries.

THIS report includes the complete range of 60-cyle pole-type Distribution transformers 15,000 volts and below through 100 kva. It thus incorporates the specification material covered by the First Report and the First Report Supplement, as well as including new information on the range 37½ to 100-kva inclusive.

BOILER AUXILIARIES 1940-41

EEI. Pub. I-4. A report of the Boiler Auxiliaries Subcommittee of the Prime Movers Committee, Edison Electric Institute, 44 pages. Price 80c to members and their employees; $2.00 to non-members in the U.S.A.; $2.15 to foreign countries.

THIS report contains statements by the subcommittee, operating companies, and manufacturers, covering operating and design problems related to boiler auxiliaries which are of particular concern to operators of steam generating equipment at this time, together with descriptions of new developments.

STANDARDIZATION OF ELECTRIC WATER HEATING EQUIPMENT

EEI. Pub. I-5. An interim report of the Electric Water Heating Committee of the Edison Electric Institute, 6 pages. Price 20c to members and their employees; 50c to non-members in the U.S.A.; 60c to foreign countries.

THIS report briefly summarizes the results of a study on the standardization of electric water heating equipment made by the Electric Water Heating Committee and sets forth certain recommendations for consideration of the electric utility industry.

METALLURGY AND PIPING, 1940

EEI. Pub. I-6. A report of the Metallurgical and Piping Subcommittee of the Prime Movers Committee. Edison Electric Institute, 36 pages. Price 70c to members and their employees; $1.75 to non-members in the U.S.A.; $1.85 to foreign countries.

THIS report contains statements by operating companies and manufacturers on:

- Collecting data on creep in pipe and superheater tubing
- Station piping in high temperature service
- Large capacity reducing valves
- Power plant bolting in high temperature service

FREQUENCY WEIGHTING FOR MESSAGE CIRCUIT NOISE

EEI. Pub. I-7. Engineering report No. 45. A report of the Joint Subcommittee on Development and Research, Edison Electric Institute and Bell Telephone System, 12 pages. Price 20c to members and their employees; 50c to non-members in the U.S.A.; 60c to foreign countries.

(See review on page 34)

SUSCEPTIVENESS OF SUBSCRIBER STATION SETS

EEI. Pub. I-8. Engineering report. No. 46. A report of the Joint Subcommittee on Development and Research, Edison Electric Institute and Bell Telephone System, 32 pages. Price 60c to members and their employees; $1.50 to non-members in the U.S.A.; $1.60 to foreign countries.

(See revision on page 34)

PERSONALS

JAMES F. OWENS, president of the Oklahoma Gas and Electric Company since 1931 has become Chairman of the Board. BRIG. GEN. GEORGE A. DAVIS, formerly executive vice-president has been named president of the company.

Mr. Owens entered the public utility business as manager of the Baldwin Gas Company, Baldwin, Kansas, in 1905 and managed the Wagoner Gas Company at Wagoner, Okla., from 1906 to 1908 when he became general superintendent of the Caney River Gas Company. In 1910 he joined the Byllesby organization as superintendent of the gas department of the Muskogee Gas and Electric Company holding that until 1915 when he became superintendent of gas construction and in 1917 he became manager of the company. In 1918 he was elected vice-president and general manager of the Oklahoma Gas and Electric Company and elected president in May, 1931. During his entire career as a public utility executive, Mr. Owens has taken active leadership in many phases of association activities, including service as president of the National Electric Light Association and of the U. S. Chamber of Commerce. He has served on the Operating Committee of the Institute since its organization.

General Davis joined the Byllesby Engineering and Management Corp. in 1919 and the following year became identified with the Oklahoma Gas and Electric organization. He had had varied and extensive experience in publicity and advertising work before entering the public utility industry. General Davis has been closely associated with the army since his college days in 1902. He saw service on the Mexican border and in France. As a member of the 45th Division, Oklahoma National Guard, General Davis about a year ago accepted the Governor's request to become Adjutant-General of the state of Oklahoma in command of all state stroops, with the rank of Brigadier-General. Today, in addition to his utility duties, he is charged with organization of civilian defense of the state under the Governor's direction.

FRANK R. PHILLIPS, President of the Philadelphia Company and Subsidiary Companies of Pittsburgh, Pennsylvania, has been elected to the position of Chairman of the Board and Chairman of the Executive Committee following his resignation as President of the Company.

LEO T. CROWLEY, a member of the Board of Directors, was elected to succeed Mr. Phillips as President of the Philadelphia Company and PHILIP A. FLEGER, General Attorney, was elected to position of Senior Vice-President of the company. The election took place at special stockholder's and Board of Directors Meetings held in Pittsburgh, January 20th.

Mr. Fleger came to the company in 1926 and served as an attorney in the Law Department, and assistant general attorney until 1939, when he was made General Attorney for the Companies. He was born in Chicago, Illinois, and educated in the University of Illinois and the University of West Virginia.

At the same time at a special meeting of the Board of Directors of the Duquesne Light Company, PRESSLY H. MCCANCE was elected President of that Company.

Mr. McCance has been associated with the Philadelphia Company and its subsidiaries since 1923. He is a native Pittsburgher and was graduated from Princeton University and the Law School of the University of Pittsburgh. He came to the Company as an attorney in the Law Department in 1923, served as Director of Personnel from 1929 to 1938, was made Vice-President of the Philadelphia Company in 1938 and was named Senior Vice-President of the Duquesne Light and Equitable Gas Companies in 1940.

HENRY H. CARPENTER has been appointed chief industrial service engineer of the Blackstone Valley Gas and Electric Co., Pawtucket, R. I., succeeding Lester H. Knapp, now vice-president. Mr. Carpenter joined the Stone and Webster organization upon being graduated from Harvard College in 1916 and had varied experience in several public utilities (with time out for army service in World War I) until 1924. In that year he became industrial service engineer of the Blackstone Valley company with headquarters at Woonsocket, covering the northern division of its activities and rising to the post of assistant chief industrial service engineer.

ARTHUR S. KIRK of the power sales staff of the Blackstone Valley Gas and Electric Co., Woonsocket, R. I., has been named assistant chief industrial service engineer, succeeding Mr. Carpenter. Mr. Kirk was educated at Boston University, served in the U. S. Navy in the previous war and joined Stone & Webster at Boston in 1920. He was transferred to the Blackstone Valley company in 1925, and two years later was made industrial service engineer with headquarters at Woonsocket.

JOSEPH H. GUMZ has been appointed commercial and industrial sales manager for the Pacific Gas and Electric Company to succeed the late Harry Carroll. A graduate of the University of Illinois, Mr. Gumz entered the utility business in 1913 with Western United Gas and Electric Co. in Illinois, and later was with the Public Service Co. of Northern Illinois. He joined P. G. & E. in 1922. In his new position he will be manager of both gas and electric sales.

S. W. WILLERS, chief engineer of the Oklahoma Gas and Electric Co. at Fort Smith, has retired after more than a quarter of a century with that utility.

EDWARD M. THIERRY, formerly assistant to the President of The North American Company, has joined the public relations firm of Hill and Knowlton of New York and Cleveland. Mr. Thierry has been with North American for the last fourteen years and has specialized mainly in stockholder relations.

HENRY KRUSE, formerly merchandise sales promotion director for Puget Sound Power and Light Co., has been promoted to sales promotion manager supervising all promotion and merchandise sales.

DONALD S. KENNEDY, assistant treasurer of the Oklahoma Gas and Electric Co., has been appointed treasurer to succeed the late Bernard M. Lester. Mr. Kennedy has been connected with the company since 1923.

HARRY J. VON NIEDA, commercial sales director of the Pennsylvania Power and Light Co., at Lancaster, Pa., has retired after 35 years of service.

CHARLES E. RUSSELL has been appointed by the Philadelphia Electric Co., acting manager of the newly-created market studies and application division of the industrial and retail sales department.

Industrial Safety and the War Effort

(*Continued from page* 18)

They should also review and act upon all recommendations made by state departments or insurance representatives. New safety rules should be discussed and, in addition, each member should contribute practical suggestions that will form the basis of other safety rules which will eliminate unsafe practices or conditions.

All committee members should utilize in their own work, and pass on to other employees, the safety information they gain at meetings. Foremen can usually do this through personal talks with small groups or with individuals in their departments.

Moving pictures, film strips, lantern slides, posters and bulletin board displays are also highly effective in maintaining the interest of workers in safety. Inter-departmental and inter-plant safety contest with prizes to winning individuals or departments are also used by many companies.

The establishment of good personnel relations through credit unions, athletic events, social activities, and other means, contributes highly to a good accident record. A suggestion system, soliciting suggestions relating to safety as well as other phases of operation, also offers a tangible reward for creative-thinking employees.

The supreme objective of a safety program at this time is to assist our war effort. Bring industrial workers to realize that every accident, whether in the plant, on the highway, or in the home, is a man lost from the production army. Show them that continued, regular production is their contribution to the maintenance of our way of life. Challenge them to exhibit their patriotism by avoiding accidents. ———

Field Testing for Generator Insulation

(*Continued from page* 32)

2. Insulation Resistance of Armature Windings. R. W. Wieseman. *AIEE Transactions*, volume 53, 1934 (June section), pages 1010-21.

3. The Characteristics of Insulation Resistance, S. Evershed. *Journal* of the Institution of Electrical Engineers, volume 52, number 224, December 15, 1913, pages 51-83.

4. Circuit-Breaker Recovery Voltage, R. H. Park and W. F. Skeats. *AIEE Transactions*, volume 50, 1931, pages 204-38.

5. University of Illinois engineering experimental station *Bulletins* 259 and 260.

6. Review by T. Rich of G. J. T. Bakker and J. C. Van Staversen's paper, The Insulation of Large High-Tension Synchronous Generators. *Electrician*, volume 102, number 25, June 21, 1939, pages 249-50.

7. Predetermination of the A-C Characteristics of Dielectrics, A. Manos, Jr., and J. B. Whitehead. *AIEE Transactions*, volume 51, 1932, pages 392-403.

8. Insulation Tests of Electrical Machinery Before and After Being Placed in Service, B. L. Barns and C. M. Gilt. *AIEE Transactions*, volume 48, 1929, pages 656-65.

9. Insulation for High-Voltage Alternators, J. F. Calvert and C. M. Laffoon. *AIEE Transactions*, volume 54, 1935 (June section), pages 624-31.

10. Testing Breaker Insulation by Power-Factor Methods, F. C. Doble. *Electrical World*, volume 98, number 9, August 29, 1931, pages 374-5.

11. Testing Electrical Insulation, E. L. Doty. *Electric Journal*, volume 35, May 1938 pages 183-5.

12. Insulating Materials—Conditions Which Cause Deterioration, A. R. Dunton. *The Electrician*, volume 107, October 9, 1931, pages 483-5.

13. Dielectric Strength Ratio Between Alternating and Direct Voltages, W. N. Eddy and J. L. R. Hayden. *AIEE Transactions*, volume 42, 1923, pages 593-9; discussion, pages 612-20.

14. Reconditioning Flood-Damaged Electrical Equipment. Publication number *F13*, Edison Electric Institute, December 1938.

15. The Effect of Heat on the Electric Strength of Some Commercial Insulating Materials, W. S. Flight. *Journal* of the Institution of Electrical Engineers, volume 60, February 1922, pages 218-35.

16. Testing Bushings and Insulation by Power-Factor Method, I. W. Gross and H. E. Turner. *Electrical World*, volume 103, numbers 2 and 3, January 13 and 20, 1934, pages 68-73 and 111-16.

17. The Properties of Dielectrics in Electric Fields Comprising Unidirectional and Alternating Components, L. Hartshorn and E. Rushton. The British Electrical and Allied Industries Research Association, London, WC2; *Technical Report* L/T 79, July 28, 1936.

18. Improvements in Insulation for High-Voltage A-C Generators, C. F. Hill. *AIEE Transactions*, volume 47, 1928, pages 845-52.

19. High-Voltage Measurements on Cables and Insulators, C. L. Kasson. *AIEE Transactions*, volume 46, 1927, pages 635-47.

20. An Automatic A-C Potentiometer and Its Application to the Nondestruction Testing of Insulating Equipment, G. Keinath. *AIEE Transactions*, volume 58, 1939, pages 887-90.

21. The Influence of Moisture Upon the D-C Conductivity of Impregnated Paper, G. T. Kohman and D. C. McLean. *Journal* of the Franklin Institute, volume 226, August 1938, pages 203-20.

22. The Predominating Influence of Moisture and Electrolytic Material Upon Textiles as Insulators, E. J. Murphy and R. R. William. *AIEE Transactions*, volume 48, 1929, pages 568-75.

23. Testing of Insulation, C. R. Reid. *Electrical News and Engineering*, volume 46, July 1, 1937, page 212.

24. Temperature Limits and Characteristics of Mica as Used in Conjunction With Class "B" Insulation, Robert H. Spry. *AIEE Transactions*, volume 58, 1939 (June section), pages 287-9.

25. The Physics of Insulating Materials, parts I-V, A. M. Thomas. *World Power*.

I—Faraday, Kelvin, Maxwell, Mossotti, Debye, Honkinson, J. J. Thomson, volume 14, December 1930, pages 485-91.

II—Dielectric Absorption and A-C Losses, volume 15, January 1931, pages 23-7.

III—Conductivity of Dielectrics, volume 15, February 1931, pages 113-15.

IV—Failure of Dielectrics Under Electric Stress—Gases and Liquids, volume 15, March 1931, pages 196-8.

V—Failure of Dielectrics Under Electric Stress—Solids, volume 15, April 1931, pages 307-10.

26. Generator-Insulation Tests, B. Van Ness. Edison Electric Institute *Bulletin*, volume 6, May 1938, pages 204-206, 231.

27. The Drying of Cellulose Insulation and Electrical Measurements as Measures of Dryness, Emerson Venable. Abstracted in *Electrical Engineering*, volume 58, January 1939, page 41.

28. Gaseous Ionization in Built-up Insulation, J. B. Whitehead. *AIEE Transactions*, volume 42, 1923, pages 921-39. Discussion, pages 953-8.

29. Gaseous Ionization in Built-up Insulation—II, J. B. Whitehead. *AIEE Transactions*, volume 43, 1924, pages 116-26.

CONVENTIONS AND MEETINGS

1942

JANUARY

21-23 American Society of Civil Engineers, New York, N. Y.
26-30 American Institute of Electrical Engineers, New York, N. Y.
26-30 American Society of Heating and Ventilating Engineers, Philadelphia, Pa.

FEBRUARY

2-3 Electrical Equipment Committee, EEI, Pittsburgh, Pa.
9-10 Prime Movers Committee, EEI, Belvedere Hotel, Baltimore, Md.
9-11 Transmission and Distribution Committee, EEI, Hotel Cleveland, Cleveland, Ohio.
16-20 National Electrical Manufacturers Association, Palmer House, Chicago, Ill.

MARCH

23-24 Oklahoma Utilities Association, Biltmore Hotel, Oklahoma City, Okla.
23-26 General Power Conference, Edgewater Beach Hotel, Chicago, Ill.

APRIL

27-30 Chamber of Commerce of the U. S. A., Washington, D. C.

MAY

6-8 Electrical Manufacturers Club, The Homestead, Hot Springs, Va.
10-15 National Electrical Manufacturers Association, The Homestead, Hot Springs, Va.
11-15 National Fire Protection Association, Atlantic City, N. J.
17-21 National Electrical Wholesalers Association, The Homestead, Hot Springs, Va.
22-26 Westinghouse Agent-Jobbers Association, The Homestead, Hot Springs, Va.
25-28 National Association of Purchasing Agents, New York, N. Y.

JUNE

1-4 EDISON ELECTRIC INSTITUTE, annual convention, Atlantic City, N. J.

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1941-1942

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420 Lexington Avenue, New York, N. Y.

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G. W. VAN DERZEE, Wisconsin Electric Power Co., Milwaukee, Wis.

P. S. YOUNG, Public Service Electric & Gas Co., Newark, N. J.

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Accident Prevention, GEORGE S. DIEHL, Pennsylvania Water & Power Co., Baltimore, Md.

Accounting Executive, G. H. BOURNE, The Commonwealth & Southern Corp., New York, N. Y.

Customers' Relations, Commercial Accounting and Collections, H. R. FLANEGAN, Philadelphia Electric Co., Philadelphia, Pa.

Depreciation, H. L. GRUEHN, Consolidated Gas Electric Light & Power Co., Baltimore, Md.

General Accounting, to be announced.

Plant Accounting and Records, H. B. HARDWICK, The Commonwealth & Southern Corp., New York, N. Y.

Purchasing Stores and Transportation, W. P. MCARDLE, Ebasco Services, Inc., New York, N. Y.

Electrical Equipment, R. W. WILBRAHAM, United Engineers & Constructors, Inc., Philadelphia, Pa.

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Prize Awards, H. P. LIVERSIDGE, Philadelphia Electric Co., Philadelphia, Pa.

Rate Research, F. A. NEWTON, The Commonwealth & Souther Corp., New York, N. Y.

General Commercial, R. E. FISHER, Pacific Gas & Electric Co., San Francisco, Cal.

Statistical, W. G. BOURNE, JR., The Commonwealth & Southern Corp., New York, N. Y.

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Codes and Standards (a Subcommittee of the Operating Committee)
H. B. BRYANS, Philadelphia Electric Co., Philadelphia, Pa.

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OF THE
EDISON ELECTRIC INSTITUTE
1941-1942

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(Terms expiring 1944)

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